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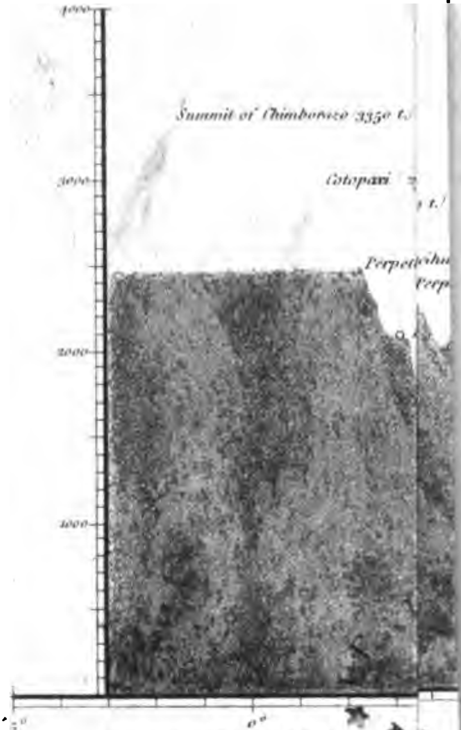

Perpetual snow under the Equator
according to Bouguer & Humboldt

12 — 103

Personal Narrative
OF TRAVELS
TO THE
EQUINOCTIAL REGIONS
OF THE
NEW CONTINENT,
DURING THE YEARS 1799—1804,

BY

ALEXANDER DE HUMBOLDT,

AND

AIMÉ BONPLAND;

WITH MAPS, PLANS, &c.

WRITTEN IN FRENCH BY
ALEXANDER DE HUMBOLDT,

AND TRANSLATED INTO ENGLISH BY
HELEN MARIA WILLIAMS.

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JOURNEY

TO THE

EQUINOCTIAL REGIONS

OF

THE NEW CONTINENT.

BOOK V.

CHAPTER XIV.

Earthquakes at Caraccas.—Connection of this phenomenon with the volcanic eruptions of the West India islands.

We left Caraccas on the 7th of February, in the cool of the evening, and began our journey to the Oroonoko. The remembrance of that departure is more painful to us now, than it was some years ago. Our friends have perished in the sanguinary revolutions, which have successively given liberty to those distant regions, and deprived them of it. The house which we inhabited is now a heap of ruins. Tremendous earthquakes have changed the surface of the soil. The city, which I have described, has disappeared; and on the same spot, on the ground fissured in various directions, another city is slowly rising. Already those heaps of ruins, the grave of a numerous population, are become anew the habitation of men.

In retracing changes of so general an interest, I shall be led to notice events, that took place long after my return to Europe. I shall pass over in silence the popular commotions, and the modifications which the state of society has undergone. Modern nations, careful of their own remembrance, snatch from oblivion the history of human revolutions, which is that of ardent passions, and inveterate hatred. It is not the same with respect to the revolutions of the physical world. These are described with the least accuracy, when they happen to coincide with the period of civil dissentions. Earthquakes and the eruptions of volcanoes strike the imagination by the evils, which are their necessary consequence. Tradition seizes in preference whatever is vague and marvellous; and amid great public calamities, as in private misfortunes, man seems to shun that light, which leads us to discover the real causes of events, and recognise the circumstances by which they are attended. I have thought proper to record in this work all I have been able to collect with certainty respecting the earthquake of the 26th of March, 1812, which destroyed the town of Caraccas; and by which more than twenty thousand persons perished almost at the same instant in the province of Venezuela. The intercourse which I have kept up with persons of all classes has enabled me, to compare the description of many eyewitnesses, and to interrogate them on objects, that may throw light on physical science in general. The traveller, being the historian of nature, should authenticate the dates of great catastrophes, examine their connection and mutual relations, and mark in the rapid course of ages, in this continual progress of successive changes, those fixed points, with which other catastrophes may one day be compared. All epochas approach each other in the immensity of time comprehended in the history of nature. Years passed away seem but a few instants; and if the physical descriptions of a country do not excite a very powerful and general interest, they have at least the advantage of never becoming old. Similar considerations, no doubt, led Mr. de la Condamine to describe in his *Voyage à l'Equateur*, the memorable eruptions* of the volcano of Cotopaxi, which took place long after his departure from Quito. Following the example of this celebrated traveller, I think I shall the less deserve blame, as the events which I am going to relate will serve to elucidate the theory of *volcanic reactions*, or the influence of a *system of volcanoes* on a vast space of circumjacent country.

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* Those of the 30th of November 1744, and of the 3d of September 1750. (*Introd. Hist.*, p. 156, and 160.)

At the time that Mr. Bonpland and myself inhabited the provinces of New Andalusia, Nueva-Barcelona, and Caraccas, a general opinion prevailed, that the easternmost parts of these coasts were the most exposed to the destructive effects of earthquakes. The inhabitants of Cumana dreaded the valley of Caraccas, on account of its damp and variable climate, and its gloomy and foggy sky; while the inhabitants of that temperate valley considered Cumana as a town, where only a burning air was breathed, and where the soil is periodically agitated by violent commotions. Forgetful of the overthrow of Riobamba, and other very elevated towns; ignorant that the peninsula of Araya, composed of mica-slate, has partaken of the commotions of the calcareous coast of Cumana; well-informed persons thought they perceived motives of security in the structure of the primitive rocks of Caraccas, as well as in the elevated situation of this valley. Religious ceremonies celebrated at La Guayra, and even in the capital, in the middle of the night*, recalled no doubt to their memory, that the province of Venezuela had been subject at intervals to earthquakes; but dangers that seldom recur are slightly feared. Cruel experience destroyed, in 1811, the charm of theory, and of popular opinions. Caraccas, situate in the mountains, three degrees west of Cumana, and five degrees west of the volcanoes of the Caribbee islands, has felt greater shocks, than were ever experienced on the coast of Paria or New Andalusia.

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* For instance, the nocturnal procession of the 21st of October, instituted in commemoration of the great earth-

At my arrival in Terra Firma, I was struck with the connection of two physical events, the destruction of Cumana on the 14th of December, 1797, and the eruption of the volcanoes in the smaller West India islands*. This connection has been again manifested in the destruction of Caraccas on the 26th of March, 1812. The volcano of Guadaloupe seemed to have reacted, in 1797, on the coasts of Cumana. Fifteen years after, it was a volcano situate nearer the continent, that of St. Vincent's, which appeared to have extended it's influence as far as Caraccas and the banks of the Apure. It is possible, that at these two epochas the centre of the explosion was at an immense depth, equally distant from

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quake, which took place on that day of the month, at one in the morning, in 1778. Other very violent shocks were those of 1641, 1703, and 1802.

* See vol. ii, p. 231.

the regions toward which the motion was propagated at the surface of the globe.

From the beginning of 1811 till 1813, a vast extent of the Earth*, limited by the meridian of the Azores, the valley of the Ohio, the Cordilleras of New Grenada, the coasts of Venezuela, and the volcanoes of the smaller West India islands, has been shaken almost at the same time by commotions, which may be attributed to subterraneous fires. The following series of phenomena seems to indicate communications at enormous distances. On the 30th of January, 1811, a submarine volcano appeared near the island of St. Michael, one of the Azores. At a place, where the sea was sixty fathoms deep, a rock appeared above the surface of the waters. The heaving up of the softened crust of the globe appears to have preceded the eruption of flames by the crater†, as had already been observed at the volcanoes of Jorullo in Mexico, and at the apparition of the little island of Kameni near Santorino. The new islet of the Azores was at first nothing more than a shoal; but on the 15th of January an eruption, which lasted six days, enlarged it's extent, and carried it progressively to the height of fifty toises above the surface of the sea. This new land, of which captain Tillard hastened to take possession in the name of the British government, calling it *Sabrina island*, was nine hundred toises in diameter. It has again, it seems, been swallowed up by the ocean. This is the third time, that submarine volcanoes have presented this extraordinary spectacle near the island of St. Michael; and, as if the eruptions of these volcanoes were subject to a regular period, owing to a certain accumulation of elastic fluids, the island raised up has appeared at intervals of ninety-one or ninety-two years *. It is to be regretted, that, notwithstanding the proximity of the spot, no European government, or learned society, has sent natural philosophers and geologists to the Azores, to investigate a phenomenon, which would throw so much light on the history of volcanoes, and on that of the globe in general.

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* Between the latitudes of 5° and 36° North, and the meridians of 31° and 91° West from Paris.

† See vol. i, p. 240.

At the time of the appearance of the new island of Sabrina, the smaller West India islands, situate eight hundred leagues to the south-west of the Azores, experienced frequent earthquakes.

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* *Malte Brun, Geogra. Univ.*, vol. iii, p. 177—180. There remains however some doubt, respecting the eruption of 1628, which some place in 1638. The rising always happened near the island of St. Michael, though not identically on the same spot. It is remarkable, that the small island of 1720 reached the same elevation as the island of Sabrina in 1811. See above, vol. i, chap. i, p. 95.

More than two hundred shocks were felt from the month of May 1811, to April 1812, in the island of St. Vincent; one of the three where there are still active volcanoes. The commotion did not remain circumscribed to that insular portion of eastern America. From the 16th of December 1811, the earth was almost incessantly agitated in the valleys of the Missisippi, the Arkansas, and the Ohio. The oscillations were more feeble on the east of the Alleghanies, than to the west of these mountains, in Tennessee and Kentucky. They were accompanied by a great subterraneous noise, coming from the south-west. At the spots between New Madrid and Little Prairie, as at the Saline, north of Cincinnati, in latitude 37° 45′, the shocks were felt every day, nay almost every hour, during several months. The whole of these phenomena lasted from the 16th of December 1811, till the year 1813. The commotion, confined at first to the south, in the valley of the lower Missisippi, appeared to advance slowly toward the north *.

At the same period, when this long series of earthquakes began in the *Transalleghanian States*, in the month of December 1811, the town of Caraccas felt the first shock in calm and serene weather. This coincidence of phenomena was probably not accidental; for we must not forget, that, notwithstanding the distance which separates these countries, the low grounds of Louisiana, and the coasts of Venezuela and Cumana, belong to the same basin, that of the Gulf of Mexico. This *Mediterranean sea, with several outlets,* runs from the south-east to the north-west; and an ancient prolongation of it seems to be found in those vast plains, rising gradually thirty, fifty, and eighty toises * above the level of the ocean, covered with secondary formations, and watered by the Ohio, the Missouri, the Arkansas, and the Missisippi. When we consider geologically *the basin of the Caribbean sea, and of the Gulf of Mexico,* we find it bounded on the south by the chain of the coast of Venezuela and the Cordilleras of Merida and Pamplona; on the east by the mountains of the West India islands, and the Alleghanies; on the west by the Andes of Mexico, and the Stony Mountains †; and on the north by the very inconsiderable elevations which separate the Canadian lakes from the rivers that flow into the Missisippi. More than two thirds of this basin are covered with water. It is bordered by two ranges of active volcanoes; to the east, in the Caribbee islands, between the latitudes of 13° and 16°; and to the west in the Cordilleras of Nicaragua, Guatimala, and Mexico, between 11° and 20°. When we reflect, that the great earthquake at Lisbon, of the 1st of November 1755, was felt almost at the same moment on the coasts of Sweden, at lake Ontario, and at the island of Martinico, it will not appear too daring to suppose, that all this basin of the West Indies, from Cumana and Caraccas as far as the plains of Louisiana, may be simultaneously agitated by commotions proceeding from the same centre of action.

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* See the interesting description of these earthquakes, given by Mr. Mitchell, in the *Trans. of the Liter. and Phil. Soc. of New York*, vol. i, p. 281—308; and by Mr. Drake, in the *Nat. and Stat. View of Cincinnati*, p. 232—238.

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* Cincinnati, situated on the Ohio, in latitude 39° 6′, has only eighty-five toises absolute elevation.

† It is with regret I use this vague and improper denomination, which is given to the northern prolongation of the mountains of New Mexico. I should prefer the name of Chippewan Range, which Mr. Drake (Stat. View of Cincinnati, p. 91) and other geographers of the United States, begin to substitute for the received denomination of *Stony*

An opinion very generally prevails on the coasts of Terra Firma, that earthquakes become more frequent, when electric explosions have been very rare during some years. It is thought

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Mountains; but nations almost of the same name, very distant from each other, and speaking different languages, the Chippeways of the sources of the Missisippi, and the Chepewyans of the Slave Lake, described by Pike and Mackensie, may occasion those mountains to the south and southwest of the great Canadian lakes, which lie east and west, to

with the Stony Mountains, which run north to have been observed, at Cumana and Caraccas, that the rains were less frequently attended with thunder from the year 1792; and the total destruction of Cumana in 1797, and the commotions felt* in 1800, 1801, and 1802, at Maracaibo, Porto Cabello, and Caraccas, have not failed to be attributed to "an accumulation of electricity in the interior of the Earth." It would be difficult for a person, who has lived a long time in New Andalusia, or in the low regions of Peru, to deny, that the season the most to be dreaded from the frequency of earthquakes is that of the beginning of the rains, which is however the time of thunder storms. The atmosphere, and the state of the surface of the globe, seem to have an influence unknown to us on the changes produced at great depths; and I believe, that the connection, which some persons pretend to recognize between the absence of thunder storms and the frequency of earthquakes, is rather a physical hypothesis framed by the half-learned of the country, than the result of long experience. The coincidence of certain phenomena may be favoured by chance. The extraordinary commotions felt almost continually during two years on the borders of the Missisippi and the Ohio, and which coincided in 1812 with those of the valley of Caraccas, were preceded at Louisiana by a year almost exempt from thunder storms*. Every mind was again struck with this phenomenon. We cannot deem it strange, that in the country of Franklin a great predilection is retained for explanations founded on the theory of electricity.

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* *De Pons*, vol. i, p. 125.

The shock felt at Caraccas, in the month of December, 1811, was the only one, that preceded the horrible catastrophe of the 26th of March, 1812. The inhabitants of Terra Firma were ignorant of the agitations of the volcano in the island of St. Vincent on one side, and on the other, of those that were felt in the basin of the Missisippi, where, on the 7th and 8th of February, 1812, the earth was day and night in perpetual oscillation. A great drought prevailed at this period in the province of Venezuela. Not a single drop of rain had fallen at Caraccas, or in the country ninety leagues round, during the five months which preceded the destruction of the capital. The 26th of March was a remarkably hot day. The air was calm, and the sky unclouded. It was Holy Thursday, and a great part of the population was assembled in the churches. Nothing seemed to presage the calamities of the day. At seven minutes after four in the afternoon the first shock was felt; it was sufficiently powerful, to make the bells of the churches toll;

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* *Trans. of New York*, vol. i, p. 285; *Drake*, p. 210.

it lasted five or six seconds, during which time, the ground was in a continual undulating movement, and seemed to heave up like a boiling liquid. The danger was thought to be past, when a tremendous subterraneous noise was heard, resembling the rolling of thunder, but louder, and of longer continuance, than that heard within the tropics in time of storms. This noise preceded a perpendicular motion of three or four seconds, followed by an undulatory movement somewhat longer. The shocks were in opposite directions, from north to south, and from east to west. Nothing could resist the movement from beneath upward, and undulations crossing each other. The town of Caraccas was entirely overthrown. Thousands of the inhabitants (between nine and ten thousand) were buried under the ruins of the houses and churches. The procession had not yet set out; but the crowd was so great in the churches, that nearly three or four thousand persons were crushed by the fall of their vaulted roofs. The explosion was stronger toward the north, in that part of the town situate nearest the mountain of Avila, and the Silla. The churches of la Trinidad and Alta Gracia, which were more than one hundred and fifty feet high, and the naves of which were supported by pillars of twelve or fifteen feet diameter, left a mass of ruins scarcely exceeding five or six feet in elevation. The sinking of the ruins has been so considerable, that there now scarcely remain any vestiges of pillars or columns. The barracks, called *El Quartel de San Carlos*, situate farther north of the church of the Trinity, on the road from the Custom-house de la Pastora, almost entirely disappeared. A regiment of troops of the line, that was assembled under arms, ready to join the procession, was, with the exception of a few men, buried under the ruins of this great edifice. Nine tenths of the fine town of Caraccas were entirely destroyed. The walls of the houses that were not thrown down, as those of the street San Juan, near the Capuchin Hospital, were cracked in such a manner, that it was impossible to run the risk of inhabiting them. The effects of the earthquake were somewhat less violent in the western and southern parts of the city, between the principal square and the ravin of Caraguata. There, the cathedral, supported by enormous buttresses, remains standing *.

Estimating at nine or ten thousand the number of the dead in the city of Caraccas, we do not include those unhappy persons, who, dangerously wounded, perished several months after, for want of food and proper care. The night of Holy Thursday presented the most distressing scene of desolation and sorrow. That thick cloud of dust, which, rising above the ruins, darkened the sky like a fog, had settled on the ground. No shock was felt, and never was a night more calm, or more serene. The Moon, nearly full, illumined the rounded domes of the Silla, and the aspect of the sky formed a perfect contrast to that of the earth, covered with the dead, and heaped with ruins. Mothers were seen bearing in their arms their children, whom they hoped to recall to life. Desolate families wandered through the city, seeking a brother, a husband, a friend, of whose fate they were ignorant, and whom they believed to be lost in the crowd. The people pressed along the streets, which could no more be recognized but by long lines of ruins.

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* *Sur le Tremblement de Terre de Venezuela, en* 1812, *par M. Delpeche.* MS.

All the calamities experienced in the great catastrophes of Lisbon, Messina, Lima, and Riobamba were renewed on the fatal day of the 26th of March, 1812. "The wounded, buried under the ruins, implored by their cries the help of the passers by, and nearly two thousand were dug out. Never was pity displayed in a more affecting manner; never had it been seen more ingeniously active, than in the efforts employed to save the miserable victims, whose groans reached the ear. Implements for digging, and clearing away the ruins were entirely wanting; and the people were obliged to use their bare hands, to disinter the living. The wounded, as well as the sick who had escaped from the hospitals, were laid on the banks of the small river Guayra. They found no shelter but the foliage of trees. Beds, linen to dress the wounds, instruments of surgery, medicines, and objects of the most urgent necessity, were buried under the ruins. Every thing, even food, was wanting during the first days. Water became alike scarce in the interior of the city. The commotion had rent the pipes of the fountains; the falling in of the earth had choaked up the springs that supplied them; and it became necessary, in order to have water, to go down to the river Guayra, which was considerably swelled; and then vessels to convey the water were wanting.

"There remained a duty to be fulfilled toward the dead, enjoined at once by piety, and the dread of infection. It being impossible to inter so many thousand corpses, half-buried under the ruins, commissaries were appointed to burn the bodies: and for this purpose funeral piles were erected between the heaps of ruins. This ceremony lasted several days. Amid so many public calamities, the people devoted themselves to those religious duties, which they thought were the most fitted to appease the wrath of Heaven. Some, assembling in processions, sung funeral hymns; others, in a state of distraction, confessed themselves aloud in the streets. In this town was now repeated what had been remarked in the province of Quito, after the tremendous earthquake of 1797; a number of marriages were contracted between persons, who had neglected for many years to sanction their union by the sacerdotal benediction. Children found parents, by whom they had never till then been acknowledged; restitutions were promised by persons, who had never been accused of fraud; and families, who had long been enemies, were drawn together by the tie of common calamity." If this feeling seemed to calm the passions of some, and open the heart to pity, it had a contrary effect on others, rendering them more rigid and inhuman. In great calamities vulgar minds preserve still less goodness than strength: misfortune acts in the same manner, as the pursuits of literature and the study of nature; their happy influence is felt only by a few, giving more ardour to sentiment, more elevation to the thoughts, and more benevolence to the disposition.

"Shocks as violent as those, which in the space of one minute* overthrew the city of

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* The duration of the earthquake, that is to say the whole of the movements of undulation and rising *(undulaceon y trepidacion)*, which occasioned the horrible catastrophe of the 26th of March, 1812, was estimated by some at 50″, by others at 1′ 12″.

Caraccas, could not be confined to a small portion of the continent. Their fatal effects extended as far as the provinces of Venezuela, Varinas, and Maracaybo, along the coast; and still more to the inland mountains. La Guayra, Mayquetia, Antimano, Baruta, La Vega, San Felipe, and Merida, were almost entirely destroyed. The number of the dead exceeded four or five thousand at La Guayra, and at the town of San Felipe, near the copper mines of Aroa. It appears, that it was on a line running East-North-East, and West-South-West, from La Guayra and Caraccas to the lofty mountains of Niquitao and Merida, that the violence of the earthquake was principally directed. It was felt in the kingdom of New Grenada from the branches of the high Sierra de Santa Martha* as far as Santa Fe de Bogota and Honda, on the banks of the Magdalena, one hundred and eighty leagues from Caraccas. It was every where more violent in the Cordilleras of gneiss and mica-slate, or immediately at their foot, than in the plains: and this difference was particularly striking in the savannahs of Varinas and Casanara. (This is easily explained according to the system of those geologists, who admit, that all the chains of mountains, volcanic and not volcanic, have been formed by being raised up, as if through crevices.) In the vallies of Aragua, situate between Caraccas and the town of San Felipe, the commotions were very weak: and La Victoria, Maracay, and Valencia, scarcely suffered at all, notwithstanding their proximity to the capital. At Valecillo, a few leagues from Valencia, the earth, opening, threw out such an immense quantity of water, that it formed a new torrent. The same phenomenon took place near Porto-Cabello*. On the other hand, the lake of Maracaybo diminished sensibly. At Coro no commotion was felt, though the town is situate upon the coast, between other towns which suffered from the earthquake†." Fishermen, who had passed the day of the 26th of March in the island of Orchila, thirty leagues North-East of La Guayra, felt no shock. These differences, in the direction and propagation of the shock, are probably owing to the peculiar arrangement of the stony strata.

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* As far as Villa de Los Remedios, and even to Carthagena.

Having thus traced the effects of the earthquake to the West of Caraccas, as far as the snowy mountains of Santa Marta, and the table land of Santa Fe de Bogota, we will proceed to consider their action on the country East of the capital. The commotions were very violent beyond Caurimare, in the valley of Capaya, where they extended as far as the meridian of Cape Codera: but it is extremely remarkable, that they were very feeble on the coasts of Nueva-Barcelona, Cumana, and Paria; though these coasts are the continuation of the shore of La Guayra, and formerly known to have been often agitated by subterraneous commotions. Admitting, that the destruction of the four towns of Caraccas, La Guayra, San Felipe, and Merida, may be attributed to a volcanic focus placed under or near the island of St. Vincent, it may be conceived, that the motion might have been propagated from North-East to North-West* in a line passing through the islands of Los Hermanos, near Blanquilla, without touching the coasts of Araya, Cumana, and Nueva Barcelona. This propagation of the shock might even have taken place, without the intermediate points at the surface of the Globe, the Hermanos Islands for instance, having felt any commotion. This phenomenon is frequently remarked at Peru and Mexico, in earthquakes which have followed during ages a determinate direction. The inhabitants of the Andes say with simplicity, speaking of an intermediary ground, which is not affected by the general motion, "that it forms a bridge" *(que hace puente)*: as if they meant to indicate by this expression, that the undulations are propagated at an immense depth under an inert rock.

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* It is asserted, that in the mountains of Aroa, the ground, immediately after the great shocks, was found covered with a very fine and white earth, which appeared to have been projected through crevices.

† *Apuntamientos sobre las principales Circumstancias del Terremoto de Caracas, por Don Manuel Palacio Faxardo.* MS.

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* Nearly in a line directed South, 64° West.

Fifteen or eighteen hours after the great catastrophe, the ground remained tranquil. The night, as we have already observed, was fine and calm; and the commotions did not recommence till after the 27th. They were then attended with a very loud and long continued subterranean noise *(bramido)*. The inhabitants of Caraccas wandered into the country; but the villages and farms having suffered as much as the town, they could find no shelter till they were beyond the mountains of Los Teques, in the valleys of Aragua, and in the Llanos or Savannahs. No less than fifteen oscillations were often felt in one day. On the 5th of April there was almost as violent an earthquake, as that which overthrew the capital. During several hours the ground was in a state of perpetual undulation. Large masses of earth fell in the mountains; and enormous rocks were detached from the Silla of Caraccas. It was even asserted, and this opinion prevails still in the country, that the two domes of the Silla sunk fifty or sixty toises; but this assertion is founded on no measurement whatever. I am informed, that in the province of Quito also, the people, at every period of great commotions, imagine, that the volcano of Tunguragua is diminished in height.—It has been affirmed, in many descriptions published of the destruction of Caraccas, "that the mountain of the Silla is an extinguished volcano; that a great quantity of volcanic substances are found on the road from La Guayra to Caraccas*; that the rocks do not present any regular stratification; and that every thing bears the stamp of the action of fire." It is even added, "that, twelve years before the great catastrophe, Mr. Bonpland and myself, from our physical and mineralogical researches, had considered the Silla as a very dangerous neighbour to the city, because that mountain contained a great quantity of sulphur, and that the commotions must come from the North-East." It is seldom that natural philosophers have to justify themselves for an accomplished prediction; but I think it my duty to combat ideas, that are too easily adopted on the *local causes* of earthquakes.

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* See the account given by Mr. Drouet of Guadaloupe, translated in the *Trans. of New York,* vol. i, p, 308. The author, in giving to the Silla nine hundred toises of *absolute* height, has confounded the height of the mountain, in my measurement, above the level of the sea, with its height above the valley of Caraccas, which makes a difference of four hundred and sixty toises.

In all those places where the soil has been incessantly agitated for whole months, as at Jamaica in 1693[*], Lisbon in 1755, Cumana in 1766, and Piedmont in 1808, a volcano is expected to open. People forget, that it is far from the surface of the Earth we must seek the *focus* or centre of action; that, according to undeniable evidence, the undulations are propagated almost at the same instant across seas of an immense depth, at a distance of a thousand leagues; and that the greatest commotions take place not at the foot of active volcanoes, but in chains of mountains composed of the most heterogeneous rocks. We have given in the preceding book a geognostical description of the country round Caraccas; we there find gneiss, and mica-slates, containing beds of primitive limestone. The strata are scarcely more fractured or irregularly inclined than near Freyberg in Saxony, or wherever mountains of primitive formation rise abruptly to great heights. I there found neither basaltes nor dolerite, nor even trachytes or trap-porphyries; nor in general any trace of an extinguished volcano, unless we choose to consider the diabases or primitive *gruenstein*, contained in gneiss, as masses of lava, which have filled up fissures. These diabases are the same as those of Bohemia, Saxony, and Franconia *; and whatever opinion is entertained on the ancient causes of the oxidation of the Globe at its surface, all those primitive mountains, which contain mixtures of hornblende and feldspar, either in veins, or in balls with concentric layers, will not, I suppose, be called volcanic formations. Mont Blanc and Mont d'Or will not be ranged in the same class. The partizans of a universal volcanism, or of the ingenious Huttonian theory, themselves make a distinction between the lavas, which were melted under the simple pressure of the atmosphere at the surface of the Globe, and those layers formed by fire beneath the immense weight of the ocean and superincumbent rocks. They would not confound Auvergne and the granitic valley of Caraccas under the same denomination, that of a country of extinct volcanoes.

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[*] *Phil. Trans.* for 1694, p. 99.

I never could have uttered the opinion, that the Silla and the Cerro de Avila, mountains of gneiss and mica-slate, were a dangerous vicinage for the capital, because they contained a great deal of pyrites in *subordinate beds* of primitive limestone. But I remember having said, during my stay at Caraccas, that the eastern extremity of Terra Firma appeared, since the great earthquake of Quito, in a state of agitation, which led to an apprehension, that the province of Venezuela would gradually be subjected to violent commotions. I added, that when a country had been long subject to frequent shocks, new subterraneous communications seemed to open with neighbouring countries; and that the volcanoes of the West India islands, lying in the direction of the Silla, to the North-East of the city, were perhaps the vents by which, at the time of an eruption, those elastic fluids gushed out, that cause the earthquakes on the coasts of the continent. These considerations, founded on a local knowledge of the place, and on simple analogies, are very far from a prediction justified by the course of physical events.

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* These *gruensteins* are found in Bohemia, near Pilsen, in granite; in Saxony, in the mica-slates of Schoenberg; in Franconia, between Steeben and Lauenstein, in transition slates.

While violent commotions were felt at the same time in the valley of the Missisippi, in the island of St. Vincent, and in the province of Venezuela, the inhabitants of Caraccas, of Calabozo, situate in the midst of the steppes, and on the borders of the rio Apura, in a space of four thousand square leagues, were terrified on the 30th of April, 1812, by a subterraneous noise, which resembled frequent discharges of the largest cannon. This noise began at two in the morning. It was accompanied by no shock; and, which is very remarkable, it was as loud on the coast as at eighty leagues distance inland.

It was every where believed to be transmitted through the air; and was so far from being thought a subterraneous noise, that at Caraccas, as well as at Calabozo, preparations were made to put the place into a state of defence against an enemy, who seemed to be advancing with heavy artillery. Mr. Palacio, crossing the rio Apura below the Orivante, near the junction of the rio Nula, was told by the inhabitants, that the "*firing of cannon*" had been heard as distinctly at the western extremity of the province of Varinas, as at the port of La Guayra to the North of the chain of the coast.

The day on which the inhabitants of Terra Firma were alarmed by a subterraneous noise was that on which happened the great eruption of the volcano in the island of St. Vincent *. This mountain, near five hundred toises high, had not thrown out any lava since the year 1718. Scarcely was any smoke perceived to issue from it's top, when, in the month of May, 1811, frequent shocks announced, that the volcanic fire was either rekindled, or directed anew toward that part of the West Indies. The first eruption did not take place till the 27th of April, 1812, at noon. It was only an ejection of ashes, but attended with a tremendous noise. On the 30th, the lava passed the brink of the crater, and, after a course of four hours, reached the sea. The noise of the explosion "resembled that of alternate discharges of very large cannon and of musketry; and, which is well worthy of remark, it seemed much louder at sea, at a great distance from the island, than in sight of land, and near the burning volcano."

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* *Barbadoes Gazette for* May 6, 1812. *Bibliot. Britt.*, 1813, May, p. 90. *New England Journal of Medicine*, 1813, p. 93. *Trans. of New York*, vol. i, p. 315. *Le Blond, Voyage aux Antilles*, vol. i, p. 187.

The distance in a straight line from the volcano of St. Vincent to the rio Apura, near the mouth of the Nula, is two hundred and ten leagues *. The explosions were consequently heard at a distance equal to that between Vesuvius and Paris. This phenomenon, connected with a great number of facts observed in the Cordilleras of the Andes, shows how much more extensive the subterranean sphere of activity of a volcano is, than we are disposed to admit from the small changes effected at the surface of the Globe. The detonations heard during whole days together in the New World, eighty, one hundred, or even two hundred leagues distant from a crater, do not reach us by the propagation of the sound through the air; they are transmitted to us by the ground, perhaps in the

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* Where the contrary is not expressly stated, nautical leagues of twenty to a degree, or two thousand eight hundred and fifty-five toises, are always to be understood.

very place where we happen to be. If the eruptions of the volcano of St. Vincent, Cotopaxi, or Tunguragua, resounded from afar, like a cannon of an immense magnitude, the noise ought to have increased in the inverse ratio of the distance: but observations prove, that this augmentation does not take place. I must further observe, that Mr. Bonpland and I, going from Guayaquil to the coast of Mexico, crossed latitudes in the South Sea, where all the mariners of our ship were affrighted by a hollow sound, that came from the depth of the ocean, and was transmitted to us by the waters. It was the period of a new eruption of Cotopaxi, and we were as far distant from that volcano, as Etna from the city of Naples. The little town of Honda, on the banks of the Magdalena, is not less than one hundred and forty-five leagues* from Cotopaxi; and yet in the great explosions of this volcano, in 1744, a subterraneous noise was heard at Honda, and supposed to be discharges of heavy artillery. The monks of St. Francis spread the news, that the town of Carthagena was besieged and bombarded by the English; and the intelligence was believed throughout the country. Now the volcano of Cotopaxi is a cone, more than one thousand eight hundred toises above the basin of Honda, and rises from a table-land, the elevation of which is more than one thousand five hundred toises above the valley of the Magdalena. In all the colossal mountains of Quito, of the province of Los Pastos, and of Popayan, crevices and valleys without number are interposed. It cannot be admitted, under these circumstances, that the noise could be transmitted through the air, or by the superior surface of the Globe, and that it came from that point, where the cone and crater of Cotopaxi are placed. It appears probable, that the higher part of the kingdom of Quito and the neighbouring Cordilleras, far from being a group of distinct volcanoes, constitute a single swollen mass, an enormous volcanic wall, stretching from South to North, and the crest of which exhibits a surface of more than six hundred square leagues. Cotopaxi, Tunguragua, Antisana, and Pichincha, are placed on this same vault, on this raised ground. They are differently named, although they are only different summits of the same volcanic mass. The fire issues sometimes from one, sometimes from another of these summits. The obstructed craters appear to us to be extinguished volcanoes; but we may presume, that, while Cotopaxi or Tunguragua have only one or two eruptions in the course of a century, the fire is not less continually active under the town of Quito, under Pichincha and Imbaburu.

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* This is the distance from Vesuvius to Mont Blanc.

Advancing toward the North, we find, between the volcano of Cotopaxi and the town of Honda, two other *systems of volcanic mountains*, those of Los Pastos and of Popayan. The connection of these systems was manifested in the Andes in an incontestible manner by a phenomenon, which I have already had occasion to notice, in speaking of the last destruction of Cumana. Since the month of November, 1796, a thick column of smoke had issued from the volcano of Pasto, West of the town of that name, and near the valley of rio Guaytara. The mouths of the volcano are lateral, and placed on its western declivity, yet during three successive months the column rose so much higher than the ridge of the mountain, that it was constantly visible to the inhabitants of the town of Pasto. They related to us their astonishment, when, on the 4th of February, 1797, they observed the smoke disappear in an instant, without feeling any shock whatever. At that very moment, sixty-five leagues to the South, between Chimborazo, Tunguragua, and the Altar (Capac-Urcu), the town of Riobamba was overthrown by the most dreadful earthquake, of which tradition has transmitted the history. Is it possible to doubt from this coincidence of phenomena, that the vapours, issuing from the small apertures or *ventanillas* of the volcano of Pasto, had an influence on the pressure of those elastic fluids, which shook the ground of the kingdom of Quito, and destroyed in a few minutes thirty or forty thousand inhabitants?

In order to explain these great effects of *volcanic reactions*, and to prove, that the group or system of the volcanoes of the West India Islands may sometimes shake the continent, it was necessary to cite the Cordillera of the Andes. Geological reasoning can be supported only on the analogy of facts that are recent, and consequently well authenticated: and in what other region of the Globe could we find greater and at the same time more varied volcanic phenomena, than in that double chain of mountains heaved up by fire? in that land, where Nature has covered every summit and every valley with her marvels? If we consider a burning crater only as an isolated phenomenon, if we satisfy ourselves with examining the mass of stony substances which it has thrown up, the volcanic action at the surface of the Globe will appear neither very powerful, nor very extensive. But the image of this action swells in the mind, when we study the relations that link together volcanoes of the same group; for instance those of Naples and Sicily, of the Canary islands *, of the Azores, of the Caribbee islands, of Mexico, of Guatimala, and of the table-land of Quito; when we examine either the reäctions of these different systems of volcanoes on one another, or the distance to which, by subterranean communications, they at the same moment shake the Earth.

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* I have already related, vol. 1, p. 249, how the whole group of the Canary islands are placed, as we may say, on one and the same submarine volcano; the fire of which,

The study of volcanoes presents two very distinct branches; the object of one, simply mineralogical, is the examination of the stony strata, altered or produced by the action of fire; from the formation of the trachytes or trap porphyries, of basalts, phonolites, and dole-

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since the sixteenth century, has made it's appearance alternately in Palma, Teneriffe, and Lancerota. Auvergne presents us with a whole system of volcanoes, the action of which has ceased; but in the middle of a system of active volcanoes, for instance, in that of Quito, we must not consider as an *extinguished volcano* a mountain, the crater of which is obstructed, and through which the subterraneous fire has not issued for ages. Etna, the Eolian isles, Vesuvius, and Epomeo; the peak of Teyde, Palma, and Lancerota; St. Michael, la Caldiera de Fayal, and Pico; St. Vincent, St. Lucia, and Guadaloupe; Orizava, Popocatepec, Jorullo, and la Colima; Bombacho, the volcano of Granada, Telica, Momotombo, Isalco, and the volcano of Guatimala; Cotopaxi, Tunguragua, Pichincha, Antisana, and Sangay, belong to the same *system of burning volcanoes;* they are generally ranged in rows, as if they had issued from a crevice, or vein not filled up; and, what is very remarkable, their position is in some parts in the general direction of the Cordilleras, and in others in a contrary direction. (*Essai politique sur le Mexique*, tom. 1, p. 253.

rites, to the most recent lavas; the other, less accessible and more neglected, comprehends the physical relations which link volcanoes together, the influence of one volcanic system on another, the connection that manifests itself between the action of burning mountains and the commotions which shake the earth at great distances, and during a long time, in the same direction. This study cannot make any progress, till the various epochas of simultaneous action, the direction, the extent, and the force of the commotions, are carefully noted; as well as their progressive advance toward regions, which they had not yet reached*; and that coincidence between distant volcanic eruptions and those subterranean noises, which, on account of their force, the inhabitants of the Andes denominate in a very expressive manner *subterraneous thunders*, or *roarings*. All these objects are comprehended in the domain of *the history of nature*, a science which has not even preserved it's name, and the origin of which, like that of all other histories, begins with times which appear to us fabulous, and catastrophes, of which our imagination cannot embrace the violence and magnitude.

The study of the history of nature has been long confined to that of the ancient documents buried in the entrails of the Earth; but if the narrow circle, in which all certain traditions are confined, do not present any of those general revolutions, which have heaved up the Cordilleras, and buried myriads of pelagian animals, Nature, acting under our eyes, does not less exhibit tumultuous though partial changes, the study of which may throw light on the most remote epochs. Those mysterious powers reside in the interior of the Earth, the effects of which are manifested at the surface by the production of vapours, of incandescent slags, of new volcanic rocks and thermal springs, by the appearance of new islands and mountains, by commotions propagated with the rapidity of an electric shock, finally by those subterranean thunders *, which are heard during whole

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* See vol. ii, p. 280.

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* Those which alarmed the inhabitants of the town of Guanaxuato, in Mexico, lasted from the 9th of January till the 12th of February, 1784. This phenomenon, almost without example among those accurately observed, will be described in the sequel of this *Narrative*. It is sufficient here to observe, that the town is situate forty leagues North of the volcano of Jorullo, and sixty leagues North-West of the volcano of Popocatepetl. In places nearer these two volcanoes, three leagues distant from Guanaxuato, the subterraneous thunders were not heard. The noise was circumscribed within a very narrow space, in the region of a primitive schist, which approaches a transition schist, containing the richest silver mines of the known world, and on which rest trap porphyries, slates, and diabasis *(gruenstein)*.

months, without shaking the earth, in regions far distant from active volcanoes.

In proportion as equinoctial America shall increase in culture and population, and the system of volcanoes of the central table-land of Mexico, of the Caribbee islands, of Popayan, of Los Pastos, and Quito, are more attentively observed, the connection of eruptions and of earthquakes, which precede and sometimes accompany these eruptions, will be more generally recognized. The volcanoes we have just mentioned, particularly those of the Andes, which rise above the enormous height of two thousand five hundred toises, present great advantages for observation. The periods of their eruptions are singularly regular. They remain thirty or forty years without emitting scoriæ, ashes, or even vapours. In this interval, I could not perceive the smallest trace of smoke on the summit of Tunguragua or Cotopaxi. A gust of vapours, issuing from the crater of Mount Vesuvius, scarcely attracts the attention of the inhabitants of Naples, accustomed to the movements of that little volcano, which throws out slags sometimes during two or three years successively. It thence becomes difficult to judge, whether the emission of slags have been more frequent at the time when an earthquake has been felt in the Apennines. On the ridge of the Cordilleras every thing assumes a more decided character. An eruption of ashes, which lasts only a few minutes, is often followed by a calm of ten years. In such circumstances, it is easy to mark the periods, and recognize the coincidence of phenomena.

Admitting what we cannot doubt, that the destruction of Cumana in 1797, and that of Caraccas in 1812, indicate the influence of the volcanoes of the Caribbee islands * on the commotions felt on the coasts of Terra Firma, it will be advantageous, before we close this

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* The following is the series of the phenomena:

27th of September, 1796. Eruption in the West India islands. Volcano of Guadaloupe.

November, 1796. The volcano of Pasto begins to emit smoke.

14th of December, 1796. Destruction of Cumana.

4th of February, 1797. Destruction of Riobamba.

30th of January, 1811. Appearance of Sabrina island, in the Azores. It increases particularly on the 15th of June, 1811.

May, 1811. Beginning of the earthquakes in the island St. Vincent, which lasted till May, 1812.

16th of December, 1811. Beginning of the commotions in the Valley of the Missisippi and the Ohio, which lasted till 1813.

December, 1811. Earthquake at Caraccas.

26th of March, 1811. Destruction of Caraccas. Earthquakes which continued till 1813.

30th of April, 1811. Eruption of the volcano in St. Vincent's; and the same day subterranean noises at Caraccas, and on the banks of the Apura.

chapter, to take a rapid view of this Mediterranean Archipelago. The volcanic islands form one fifth of that great arch extending from the coast of Paria to the peninsula of Florida. Running from South to North, they close this interior sea on the eastern side, while the Greater West India islands appear like the remains of a group of primitive mountains, the summit of which seems to have been between Cape Abacou, Point Morant, and the *Copper Mountains*, at that spot, where the islands of St. Domingo, Cuba, and Jamaica, are nearest to each other. Considering the basin of the Atlantic as an immense *valley* *, which separates the two continents, and where, from 20° South to 30° North, the saliant angles (Brazil and

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* See my first geological sketch of South America, published by Mr. de la Metherie in the *Journal de Physique*, vol. liii, p. 33. The coasts of the ancient continent, between 5° and 10° North, have the same direction (from S. E. to N. W.) as the coasts of America between 8° South and 10° North. The direction of the coasts is, on the contrary, from S. W. to N. E. in America, between 30° and 72°; and in the ancient continent between 25° and 70°. The valley is narrowest (800 leagues) between Cape St. Roch and Sierra Leone. Proceeding toward the North along the coasts of the New Continent, from it's pyramidal extremity, or the Straits of Magellan, we imagine we recognise the effects of an impulsion directed first toward the North-East, then toward the North-West, and finally again to the North-East.

Senegambia) correspond to the entering angles (the gulf of Guinea and the sea of the West Indies), we are led to think, that the latter sea owes it's formation to the action of currents, flowing, like the *current of rotation* now existing, from East to West; and which have given the southern coast of Porto-Rico, St. Domingo, and the Island of Cuba *, so uniform a configuration. This supposition, not improbable, of an oceanic irruption, has been the source of two other hypotheses on the origin of the Smaller West India islands. Some geologists admit, that the uninterrupted chain of islands from Trinidad to Florida exhibits the remains of an ancient chain of mountains. They join the chain sometimes to the granite of French Guiana, sometimes to the calcareous mountains of Paria. Others, struck with the difference of geognostical constitution between the primitive mountains of the Greater West India islands and the volcanic cones of the Less, consider these last as having risen from the bottom of the sea.

If we recollect, that volcanic swellings, when they take place through elongated crevices, affect most commonly a straight direction, we shall find it difficult to judge from the disposition of the craters alone, whether the volcanoes have belonged to the same chain, or have always been isolated. Supposing an irruption of the ocean to take place either in the eastern part of the island of Java *, or in the Cordilleras of Guatimala and Nicaragua, where so many burning mountains form but one chain, that chain would be divided into several islands, and perfectly resemble the Caribbean Archipelago. The union of primitive formations and volcanic rocks in the same range of mountain has nothing in it strange: it is very distinctly to be seen in my geognostical *sections* of the Cordillera of the Andes. The trachytes and basaltes of Popayan are separated from the system of the volcanoes of Quito by the mica-slates of Almaguer; the volcanoes of Quito from the trachytes of Assuay by the gneiss of Condorasto and Guasunto †. There does not exist a real chain of mountains running South-East and North-West from Oyapoc to the mouths of the Oroonoko, and of which the Smaller West India islands might be a northern prolongation. The granites of Guiana, as well as the hornblende slates *, which I saw near Angostura, on the banks of the Lower Oroonoko, belong to the mountains of Pacaraimo and of Parime, stretching from West to East † in the interior of the continent, and not in a direction parallel with the coast, between the mouths of the River of Amazons and the Oroonoko. But notwithstanding we find no chain of mountains at the North-East extremity of Terra Firma, that has the same direction as the Archipelago of the Smaller West India islands, it does not follow from this circumstance alone, that the volcanic mountains of the Archipelago may not have belonged originally to the continent, to the littoral chain of Caraccas and Cumana ‡.

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* Between Cape Mayzi and Cape Cruz.

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* *Raffles*, *History of Java*, 1817, p. 23—28. The principal line of the volcanoes of Java, on a distance of 160 leagues, runs from West to East, through the mountains of Gagak, Gedé, Tankuban-Prahu, Ungarang, Merapi, Lawu, Wilis, Arjuna, Dasar, and Tashem.

† Consult the *Nivellement Barométrique*, and *Tableau des Formations des Andes*, in my *Obs. Ast.*, vol. i, p. 303, and 311, (N. 125—220.)

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* *Hornblendschiefer*, *amphibolites schistoïdes* of Brongniart.

† From the cataracts of Atures toward the Rio Esquibo. This chain of Pacaraimo divides the waters of the Carony from those of the Rio Parime, or Rio de Aguas Blancas. See my *Analyse de L'Atlas geograph.* Pl. xvi.

‡ Among the numerous examples, which the structure of the Globe displays, we shall mention only the inflexion at a right angle formed by the High Alps toward the maritime Alps, in Europe; and the Belour-tagh, which joins transversely the Mouz-tagh with Himalaya, in Asia. Amid the prejudices, which impede the progress of mineralogical geography, we may reckon, 1st, The supposition of a perfect uniformity of direction in the chains of mountains; 2d, The hypothesis of a continuity in all the chains; 3d, The supposition, that the highest summits determine the direction of a

In opposing the objections of some celebrated naturalists, I am far from maintaining the ancient contiguity of all the Smaller West India islands. I am rather inclined to consider them as islands heaved up by fire, and ranged in that regular line, of which we find the most striking examples in so many volcanic hills in Auvergne, in Mexico, and in Peru. The geognostical constitution of the Archipelago appears, from the little we know respecting it, to be very similar to that of the Azores and Canary islands. Primitive formations are no where seen above ground*;

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central chain; 4th, The idea, that in all places, where great rivers take rise, we may admit great table-lands, or very high mountains.

* According to Messrs. Moreau de Jonnès and Cortes (*Journal de Physique*, tom. lxx, p. 129). Dupuget and Leblond imagined they had recognized granite in the mountain Pelèe of Martinico, and in other parts of the Archipelago (*Voyage aux Antilles*, tom. i, p. 87, 274, and 410). Gneiss has been mentioned as forming a part of the solfatara, at St. Kit's. We cannot be too much on our guard against these indications of rocks in works, the authors of which are less familiarized with the name than with the object. How great was my surprise, when, during my stay at Santa-Fe-de-Bogota, Mr. Mutis showed me in the *Journal de Physique* for 1786, p. 321, a paper of Mr. Leblond, where this traveller, in other respects accurate, describes the table-land of Bogota, where he resided during some years, as *granitic*. We find there nothing but secondary formations, sand-stones and gypsum; not even detached fragments of granite.

we find only what belongs unquestionably to volcanoes, feldspar-lavas, dolerites, basaltes, agglomerated scoriæ, tufas, and pumice stones. Among the limestone formations we must distinguish those, which are essentially subordinate to volcanic tufas *, from those which appear to be the work of madrepores and other zoophytes. The latter, according to Mr. Moreau de Jonnès, seem to lie on shoals of a volcanic nature. Those mountains, which present traces of the action of fire more or less recent, and some of which reach nearly nine hundred toises of elevation, are all situate on the western skirt of the Smaller West India islands†. Each island

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* We have noticed some of these above (vol. iii, p. 575), after Mr. von Buch, at Lancerota, and at Fortaventura, in the System of the Canary Islands. Among the smaller islands of the West Indies, the following islets are entirely calcareous, according to Mr. Cortes: Marigalante, la Desirad, the Grand Terre of Guadaloupe, and the Grenadillas. According to the observations of this naturalist, Curasoa and Bonaire (Buen Ayre) present only calcareous formations. Mr. Cortes divides the West India islands into, 1st, those containing at once primitive, secondary, and volcanic formations, like the greater islands; 2nd, those entirely calcareous, (or at least so considered) as Marigalante and Curasoa; 3rd, those at once volcanic and calcareous, as Antigua, St. Bartholomew, St. Martin, and St. Thomas; 4th, those which display volcanic rocks only, as St. Vincent, St. Lucia, and St. Eustatia.

† See the observations of Mr. Amie, in his *Rapport sur l'Etat du Volcan de la Guadeloupe en* 1797, *p*. 17.

is not the effect of one single heaving up: most of them appear to consist of isolated masses, which have been progressively united together*. The matter has not been emitted from one mouth, but from several: so that a single island of small extent contains a whole system of volcanoes†, regions purely basaltic, and others covered with recent lavas. The volcanoes still burning are those of St. Vincent, St. Lucia, and Guadaloupe. The first threw out lavas in 1718 and 1812: in the second there is a continual formation of sulphur by the condensation of vapours, which issue from the crevices of an ancient crater. The last eruption of the volcano of Guadaloupe took place in 1797. The Solfatara of St. Christopher's was still burning in 1692. At Martinico, Vauclin, Montagne Pelée, and the crater surrounded by the five paps of Carbet, must be considered as three extinguished volcanoes. The effects of thunder have been often confounded in that place with subterranean fire. No good observation has confirmed the supposed eruption ‡ of the 22nd of January, 1792. The group of volcanoes in the Caribbee islands resembles that of the volcanoes of Quito and Los Pastos; craters, with which the subterranean fire does not appear to communicate, are ranged on the same line with burning craters, and alternate with them.

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* See above, vol. i, ch. 2, p. 255.

† These phenomena are very well indicated in the fine geological charts, that Mr. Moreau de Jonnès is going to publish.

‡ *Journal de Mines*, tom. iii, p. 59. In order to exhibit in one point of view the whole *system of the volcanoes of the*

Smaller West India islands, I shall trace in this note the direction of the islands from South to North.—*Grenada*, an ancient crater, filled with water; boiling springs; basalts between St. George and Goave.—*St. Vincent*, a burning volcano.—*St. Lucia*, a very active solfatara, named Oualibou, two or three hundred toises high; jets of hot water, by which small basins are periodically filled.—*Martinico*, three great extinguished volcanoes; Vauclin, the paps of Carbet, which are perhaps the most elevated summits of the smaller islands, and Montagne Pelée. (The height of this last mountain is probably 800 toises; according to Leblond, 670 toises; according to Dupuget, 736 toises. Between Vauclin and the feldspar-lavas of the paps of Carbet is found, as Mr. Moreau de Jonnès asserts, in a neck of land, a region of ancient basalts called *La Roche carrée*). Thermal waters of Prêcheur and Lameutin.—*Dominica*, completely volcanised.—*Guadaloupe*, an active volcano, the height of which, according to Leboucher, is 799 toises, to Amie, 850 toises.—*Montserrat*, a solfatara, fine porphyritic lavas with large crystals of feldspar and hornblende, near Galloway, according to Mr. Nugent.—*Nevis*, a solfatara.—*St. Christopher's*, a solfatara at Mount Misery.—*St. Eustatia*, a crater of an extinguished volcano, surrounded by pumice stones. (Trinidad, which is traversed by a chain of primitive slates, appears to have anciently formed a part of the littoral chain of Cumana, and not of the system of the mountains of the Caribbee islands. Edwards's History of the West Indies, vol. iii, p. 275. Dauxion Lavaysse, vol. ii, p. 60.

Notwithstanding the intimate connection, that manifests itself in the action of the volcanoes of the smaller West India islands and the earthquakes of Terra Firma, it often happens, that shocks felt in the volcanic Archipelago are not propagated to the island of Trinidad, or to the coasts of Caraccas and Cumana. This phenomenon has nothing in it surprising: even in the Caribbees the commotions are often confined to one place. The great eruption of the volcano in St. Vincent's did not occasion an earthquake at Martinico or Guadaloupe. Loud explosions were heard there, as well as at Venezuela, but the ground remained tranquil.

These explosions, which must not be confounded with the rolling noise that every where precedes the weakest commotions, are often heard on the banks of the Oroonoko, and particularly, as we were assured, on the spot between the Rio Arauca and Cuchivero. Father Morello relates, that at the mission of Cabruta the subterranean noise so much resembles discharges of small cannon (padereroes), that it has seemed as if a battle were heard at a distance. On the 21st of October, 1766, the day of the terrible earthquake that desolated the province of New Andalusia*, the ground was agitated at once at Cumana, at Caraccas, at Maracaybo, and on the banks of the Casanare, the Meta, the Oroonoko, and the Ventuario. Father Gili* has described these commotions in a country entirely granitic, at the mission of Encaramada, where they were accompanied by loud explosions. Great fallings in of the earth took place in the mountain Paurari; and near the rock Aravacoto a small island disappeared in the Oroonoko. The undulatory motion continued during a whole hour. This seemed the first signal of those violent commotions, which shook the coasts of Cumana and Cariaco for more than ten months. It might be supposed, that men scattered in woods, with no other shelter than huts of reeds and palm-leaves, had nothing to dread from earthquakes; but they terrify the Indians of Erevato and Caura, as a phenomenon that seldom happens, frightens the beasts of the forests, and impels the crocodiles to quit the depth of the waters for the shore. Nearer the sea, where the shocks are frequent, far from being dreaded by the inhabitants, they are regarded with satisfaction as the prognostics of a wet and fertile year.

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* See chap, iv, vol. ii, p. 216.

In this dissertation on the earthquakes of Terra Firma and on the volcanoes of the neighbouring Archipelago of the West India islands, I have pursued the general plan adopted in this work. I have first related a great number of solitary facts, and then considered them in one general point of view. Every thing announces in the interior of the Globe the operation of active powers, which reäct, balance, and modify one another. The greater our ignorance of the causes of these undulatory movements, these evolutions of heat, these formations of elastic fluids, the more it becomes the duty of the natural philosopher, to examine the relations existing between these phenomena at great distances, and in so uniform a manner. It is only by considering these various relations under a general point of view, and following them on a large extent of the surface of the Globe, through formations of rocks the most different, that we are led to abandon the supposition of trifling local causes, strata of pyrites, or of coal set on fire*.

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* *Saggio di Storia Americana*, vol. ii, p. 6.

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* In a work in other respects equally rich in ingenious views and well observed facts, the Geological Essays of Mr. Steffens (*Geognostisch-geologische Aufsætze*, p. 325, it is asserted, that, "hot springs, earthquakes, and volcanic erruptions, take place only where there are strata of coal, because these alone can furnish materials for combustion, and keep up, in the great electro-motive apparatus of the Earth, a strong electrical tension. If travellers have thought they have observed these phenomena in primitive formations, as recently in South America, they have confounded," continues the author, "the secondary porphyries (*flætzporphyre*) which

The following is the series of phenomena remarked on the northern coasts of Cumana, Nueva Barcelona, and Caraccas; and presumed to be connected with the causes, that produce earthquakes and eruptions of lava. We shall

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may contain strata of coal, with primitive porphyries." We have just described earthquakes in lands entirely granitic, in vast regions where, as on the banks of the Oroonoko, no other formation, primitive or secondary, rests on the granite. We shall soon see, that boiling springs gush out, as if by preference, from granite and gneiss; and that the trachytes, or trap-porphyries of the Andes, far from belonging to the formation of red sandstone, or to those *flœtzporphyries* which Messrs. Steffens and Freiesleben have so well described, issue in the midst of volcanic lands from mica-slate and gneiss. The nature and disposition of the strata in the interior of the Earth, especially in primitive formations, appear to me but little favourable to the hypothesis of a great pile, the action of which occasions shocks at the surface of the Globe, and causes (by the chemical action of the electro-motive apparatus) in brine springs and thermal waters so surprising a constancy in their mixture and specific gravity. (*Geogn. Aufs.*, p. 322 and 335). A person who has lived a long time, like me, in the Cordillera of the Andes, who has heard these explosions propagated through the interior of the Globe, who has seen those enormous effects of the heaving up of the earth, those swollen masses, which, bursting, throw out immense quantities of water, mud, and vapours, finds it difficult not to admit the existence of cavities, of communications between the oxidated part of the Globe, and that part which abounds in metalloids, in sulphurets of silex, and other substances not oxidated. See above, chap. ii, vol. i, p. 256; and chap. iv, vol. ii, p. 237.

begin with the easternmost extremity, the island of Trinidad; which, as we have said above, seems rather to belong to the shore of the continent, than to the system of the mountains of the West India islands.

The pit which throws up asphaltum in the bay of Mayaro, on the eastern coast of the island of Trinidad, to the South of Point Guataro. This is the *Mine of Chapapole* or mineral tar of the country. I was assured, that in the months of March and June the eruptions are often attended with violent explosions, smoke, and flames. Almost on the same parallel, and also in the sea, but to the West of the island (near Punta de la Brea, to the South of the port of Naparaimo), we found a similar vent. On the neighbouring coast, in a clayey ground, appears the celebrated lake of asphaltum *(Laguna de la Brea)*, a marsh, the waters of which have the same temperature as the atmosphere. The small cones situate at the South-West extremity of the island, between point Icacos and the Rio Erin, appear to have some analogy with the volcanoes of air and mud, which I met with at Turbaco in the kingdom of New Grenada*. I mention these situations of asphaltum on account of the remarkable circumstances, which are peculiar to them in these regions; for I am not unaware, that naphtha, petroleum, and asphaltum are found equally in volcanic and secondary regions *, and even more frequently in the latter. Petroleum is found floating on the sea thirty leagues North of Trinidad, around the island of Grenada, which contains an extinguished crater and basalts.

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* *Dauxion-Lavaysse, Voyage à la Trinité,* p. 25, 30, and 33.

Hot springs of Irapa, at the North-eastern extremity of New Andalusia, between Rio Caribe, Soro, and Yaguarapayo. Air-volcano, or *Salce*, of Cumacatar, to the South of San Jose and Carupano, near the northern coast of the continent, between *La Montana de Paria* and the town of Cariaco. Almost constant explosions are felt in a clayey soil, which is affirmed to be impregnated with sulphur. Thermal hydrosulphuretted waters gush out with such violence, that the ground is agitated by very sensible shocks. It is said, that flames have been frequently seen issuing out since the great earthquake of 1797. These facts are well worthy of being examined by an enlightened traveller.

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* The inflammable emanations (of hydrogen gas containing naphtha in a state of suspension) of Pietra Mala issue from the Alpine limestone, which may be traced from Covigliano to Raticofa, and which lies on ancient sandstone near Scarica l'Asino. Under this ancient sandstone (red sandstone) we find black transition limestone and the *grauwacke* (quartzose psammite) of Florence. Respecting the asphaltum of the secondary mountains of Thuringia, see *Freiesleben, Kupferschiefer*, vol. iii, p. 27; iv, p. 338. (*Hausmann Nordteutsche Beitr. St.* i, p. 93.)

Petroleum spring of Buen Pastor, near the Rio Areo. Large masses of sulphur have been found in clayey soils at Guayuta, as in the valley of San Bonifacio *, and near the junction of the Rio Pao with the Oroonoko.

Aguas calientes, on the South of the Rio Azul, and the hollow ground of Cariaco, which, at the period of the great earthquake of Cumana, threw up hydrosulphuretted waters and viscous petroleum †.

Hot waters of the Gulf of Cariaco ‡.

Petroleum spring in the same Gulf, near Maniquarez. It springs from mica-slate §.

Flames issuing from the earth, near Cumana, on the banks of the Manzanares, and at Mariguitar ||, on the southern coast of the Gulf of Cariaco, at the time of the great earthquake of 1797.

Igneous phenomena of the mountain of Cuchivano, near Cumanacoa ¶.

Petroleum spring gushing from a shoal to the

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* Chap viii, vol. iii, p. 185.

† Chap. iv, vol. ii, p. 216; and chap. viii, vol. iii, p. 186.

‡ Chap. viii, vol. iii, p. 190.

§ Chap. v, vol. ii, p. 290.

|| Chap. iv, vol ii, p. 219.

¶ Chap. vi, vol. iii, p. 81.

North of the Caraccas islands *. The smell of this spring warns ships of the danger of this shoal, on which there is only one fathom of water.

Thermal springs of the mountain of the Brigantine, near Nueva Barcelona. Temperature 43·2° cent.

Thermal springs of Provisor, near San Diego, in the province of New Barcelona.

Thermal springs of Onoto, between Turmero and Maracay, in the valleys of Aragua, to the West of Caraccas.

Thermal springs of Mariara, in the same valleys. Temperature 58·9°.

Thermal springs of Las Trincheras, between Porto Cabello and Valencia, issuing from granite, like those of Mariara, and forming a river of warm water, *Rio de Aguas Calientes.* Temperature 90·4°.

Boiling springs of the Sierra Nevada of Merida.

Aperture of Mena, on the borders of Lake Maracaybo. It throws up asphaltum, and emits (it is affirmed) gazeous emanations, which take fire of themselves, and are seen at a great distance.

These are the springs of petroleum and of thermal waters, the igneous meteors, and the ejections of muddy substances attended with explosions, of which I acquired the knowledge in the vast provinces of Venezuela, in a space of two hundred leagues from East to West. These various phenomena have singularly agitated the minds of the inhabitants since the great catastrophes of 1797 and 1812: yet they present nothing that constitutes a *volcano,* in the sense which has hitherto been attributed to this word. If the apertures, which throw up vapours and water with a violent noise, be sometimes called *volcancitos,* it is only by such of the inhabitants, as are persuaded, that volcanoes must necessarily exist in countries so frequently exposed to earthquakes. Proceeding from the burning crater of St. Vincent's to the South, the West, and South-West, first by the chain of the Caribbee islands, then by the littoral chain of Cumana and Venezuela, and finally by the Cordilleras of New Grenada, for the space of three hundred and eighty leagues, no active volcano occurs before Purace, near Popayan. One of the most remarkable geological facts is this total absence of apertures, through which melted substances can issue, in that part of the continent, which stretches to the East of the Cordillera of the Andes, and to the East of the Stony Mountains.

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* Chap. xi, vol. iii, p. 357.

We have examined in this chapter the great commotions, which shake from time to time the stony crust of the Globe, and scatter desolation in a country favoured by the most precious gifts of nature. An uninterrupted calm prevails in the superior atmosphere; but, to use an expression of Franklin's more ingenious than true, the thunder often rolls in the *subterranean atmosphere*, amid that mixture of elastic fluids, the impetuous movements of which are frequently felt at the surface of the Earth. In describing the destruction of so many populous cities, we have given a picture of the greatest calamities that afflict mankind. A nation, fighting for independance, is suddenly exposed to the want of subsistence, and of all the necessaries of life. Famished, without shelter, the inhabitants are dispersed through the country. Great numbers of those, who have escaped from the ruin of their dwellings, are swept away by disease. Far from strengthening mutual confidence among the citizens, the feeling of misfortune destroys it; physical calamities augment civil discord; nor does the aspect of a country bathed with tears and blood appease the fury of the victorious party.

After the recital of so many calamities, it is soothing to repose the imagination on consolatory remembrances. When the great catastrophe of Caraccas was known in the United States, the Congress, assembled at Washington, unanimously decreed, that five ships laden with flour should be sent to the coast of Venezuela, to be distributed among the poorest inhabitants. So generous a supply was received with the warmest gratitude; and this solemn act of a free people, this mark of a national interest, of which the increasing civilization of our old Europe displays but few recent examples, seemed to be a valuable pledge of the mutual benevolence, that ought for ever to unite the nations of both Americas.

CHAPTER XV.

Departure from Caraccas.—Mountains of San Pedro and of Los Teques.—La Victoria.—Valleys of Aragua.

To take the shortest road from Caraccas to the banks of the Oroonoko, we should have crossed the southern chain of mountains between Baruta, Salamanca, and the savannahs of Ocumare; traversed the steppes or *Llanos* of Orituca; and embarked at Cabruta, near the mouth of the Rio Guarico*. But this direct road would have deprived us of the opportunity of surveying the finest and most cultivated part of the province, the valleys of Aragua; of taking the level of an important part of the chain of the coast by means of the barometer; and of descending the Rio Apure as far as it's junction with the Oroonoko. A traveller, who has the intention of studying the configuration and natural riches of a country, is not guided by distances, but by the interest which the regions he may traverse excites in his mind. This powerful motive led us to the mountains of Los Teques, to the thermal springs of Mariara, to the fertile banks of the lake of Valencia, and through the immense savannahs of Calabozo to San Fernando de Apure, in the eastern part of the province of Varinas. Following this road, our first direction was to the West, then to the South, and finally to the East-South-East, to enter the Oroonoko by the Apure in the latitude of 7° 36′ 23″.

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* See chap. xii, vol. iii, p. 446; and the sketch of the valley of Caraccas, and the map of the lower Oroonoko in the *Atlas Geographique.*

In a journey of six or seven hundred leagues, the longitude being determined by the timekeeper from the points of Caraccas and Cumana, it became indispensable to fix with precision, and by particular observations, the situation of these two places. I have given above in the tenth chapter * the result of the astronomical observations made at the first *point of departure*, Cumana; the second point, the northernmost part of Caraccas, is situate in 10° 30′ 50″ of latitude, and 69° 25′ of longitude †. I found the magnetic variation, on the 22d of January, 1800, out of the town, near the gate of La Pastora, 4° 38′ 45″ North-East; and on the 30th of January, within the town, at the University, 4° 39′ 15″; consequently 26′ more than at Cumana. The dip of the needle was 42·9°, cent. division. The number of oscillations, measuring the intensity of the magnetic action, during 10′ of time at Caraccas, was 232; at Cumana, 229. We could not make very numerous observations: they are the result of an investigation of three months.

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* See vol. iii, p. 313.

† Mr. Ferrer, who made his observations at the Custom house, found for the latitude 10° 30′ 24″; and by the timekeeper, setting out from Porto-Rico (and admitting this place to be in 68° 28′ 3″), for the longitude 69° 23′. Ob-

The day that we quitted the capital of Venezuela, subsequently swallowed up by terrible earthquakes, we reached the foot of the woody mountains, that close the valley toward the South-West, where we slept. We followed the right bank of the Rio Guayra as far as the village of Antimano, by a very fine road, partly scooped out of the rock; and passed by La Vega, and Carapa. The church of La Vega

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servations merely celestial give me for the Square of La Trinidad,

By lunar distances from the Sun and the stars, - $4^h\ 37'\ 27''$
By occultations of satellites - - - - $4^h\ 37'\ 53''$

Mean - $4^h\ 37'\ 40''$

See *Recueil d' Obs. Ast.*, vol. i, p. 158—184. We exclude a chronometrical determination, because of the tossing of the boat, near Cape Codera, in a rough sea.

displays itself in a very picturesque manner on a range of hills covered with thick vegetation. Scattered houses are surrounded with date-trees, and seem to proclaim the easy circumstances of their inhabitants. A chain of low mountains separates the little river Guayra from the valley of *La Pascua* *, so much celebrated in the history of the country, and from the ancient gold-mines of Baruta and Oripoto. Ascending toward Carapa, we enjoy once more the sight of the Silla, which appears like an immense dome with a cliff toward the sea. This rounded summit, and the ridge of Galipano crenated like a wall, are the only objects, that in this basin of gneiss and mica-slate impress a character on the landscape. The other mountains are of a uniform and dull monotonous aspect.

A little before reaching the village of Antimano, we find on the right a very curious geological phenomenon. In hollowing the new road out of the rock, two large veins of gneiss were discovered in the mica-slate. They are nearly perpendicular, cut all the mica-slate strata *, and are nearly from six to eight toises thick. These veins contain, not fragments, but balls or spheres of granular diabasis †, formed of concentric layers. These balls are composed of lamellar feldspar and hornblende intimately mixed together. The feldspar approaches sometimes to vitreous feldspar, when it is disseminated in very thin laminæ in a mass of granular diabasis, decomposed, and emitting a strong argillaceous smell. The diameter of the spheres is very unequal, sometimes four or eight inches, sometimes three or four feet; their nucleus is more dense, without concentric layers, and of a bottle-green, inclining to black. I could not perceive any mica in them; but, what is very remarkable, great quantities of disseminated

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* Valley of Cortes, or Easter Valley, so called because Diego de Losada, after having defeated the Teques Indians, and their cacique Guaycapuro, in the mountains of San Pedro, spent his Easter there in 1567, before entering the valley of San Francisco, where he founded the city of Caraccas. (Oviedo, p. 252.)

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* The direction of the mica-slate is hor. 12·2; dip, 72° East. Veins of gneiss, and even of granite, of new formation, are very common in the metalliferous mountains *(Erzgebirge)* of Saxony; which, as we have already remarked, bear much analogy to the environs of Caraccas. There are veins of granite in the gneiss at Geyer, and in the mica-slate of Johanngeorgenstadt.

† *Ur-gruenstein.* I remember having seen similar balls filling a vein in transition-slate, near the castle of Schauenstein, in the margraviat of Bayreuth. I sent several balls from Antimano to the collection of the king of Spain at Madrid. See the description of the geological specimens from Caraccas, in my letter to Don Joseph Clavijo. *(Ann. de Hist. Nat.*, vol. ii, p. 262—271.)

garnets. These garnets, of a very fine red, are found in the gruenstein alone, and not in the gneiss, which serves as a cement to the balls, or in the mica-slate, which the veins traverse. The gneiss, the constituent parts of which are in a state of considerable disaggregation, contains large crystals of feldspar; and, though it forms the body of the vein in the mica-slate, it is traversed itself by threads of quartz two inches thick, and of a very recent formation. The aspect of this phenomenon is very curious: it appears as if cannon-balls were embedded in a wall of rocks. I also thought I recognized in these same regions, in the *Montana de Avila*, and at Cape Blanco, East of La Guayra, a granular diabasis, mixed with a small quantity of quartz and pyrites, and destitute of garnets, not in veins, but in subordinate strata in the mica-slate. This mode of position is unquestionably to be found in Europe in primitive mountains; but in general the granular diabasis is more frequently connected with the system of transition rocks, especially with a schist *(Uebergangsthonschiefer)* abounding in beds of lydian-stone strongly carburetted, of schistoid-jasper*, ampelites †, and black limestone.

Near Antimano all the orchards were full of peach-trees loaded with flowers. This village, the *Valle*, and the banks of the Macarao, furnish great abundance of peaches, quinces, and other European fruits for the market of Caraccas. Between Antimano and Ajuntas we crossed the Rio Guayra seventeen times. The road is very fatiguing; yet, instead of constituting a new one, it would perhaps be better, to change the bed of the river, which loses a great quantity of water by the combined effects of filtration and evaporation. Each sinuosity forms a marsh more or less extensive. This loss of water is to be regretted in a province, the whole cultivated region of which, with the exception of the land between the sea and the littoral chain of Mariara and Niguatar, is extremely dry. The rains are much less frequent and less violent in this place, than in the interior of New Andalusia, at Cumanacoa, and on the banks of the Guarapiche. Many of the mountains of Caraccas enter the region of the clouds; but the strata of primitive rocks dip at an angle of 70° or 80°, and generally toward the North-West, so that the waters are either lost in the interior of the Earth, or gush out in copious springs, not toward the South, but to the North of the mountains of the coast of Niguatar, Avila, and Mariara. The rising of the gneiss and mica-slate strata toward the South appears to me, to explain in great part the extreme humidity of the coast. In the interior of the province we meet with spaces of land, two or three leagues square, quite destitute of springs. The sugar-cane, indigo, and coffee, can grow only in places where running waters can be made to supply the artificial irrigations necessary during very dry weather. The first colonists very imprudently destroyed the forests. Evaporation is enormous on a stony soil surrounded with rocks, that radiate heat on every side. The mountains of the coast appear like a wall, extending East and West from Cape Codera toward Point Tucacas. They prevent the humid air of the shore, those inferior strata of the atmosphere resting immediately on the sea, and dissolving the largest proportion of water, from penetrating to the inlands. There are few apertures, few ravines, which, like those of Catia, or of Tipe *, lead from the coast to the high longitudinal valleys. No bed of a great river, no gulf allowing the sea to flow into the lands, spreads moisture by an abundant evaporation. In the eighth and tenth degrees of latitude, in regions where the clouds do not glide along the soil, many trees are stripped of their leaves in the months of January and February; not on account of the sinking of the temperature, as in Europe, but because the air, at this season, the farthest

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* *Kieselschiefer.*

† *Alaunschiefer.*

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* Chap. xii, vol. iii, p. 455; and chap. xiii, p. 532.

from that of rains, has nearly attained it's maximum of dryness. The plants with very tough and glossy leaves alone resist this absence of humidity. Beneath the fine sky of the tropics, the traveller is struck with the aspect almost hibernal of the country; but the freshest verdure again appears, when he has reached the banks of the Oroonoko, where another climate prevails; and the great forests preserve by their shade a certain quantity of moisture in the soil, which they shelter from the devouring ardor of the Sun.

Beyond the small village of Antimano the valley becomes much narrower. The river is bordered with *lata*, that fine gramineous plant with distich leaves, which sometimes reaches the height of thirty feet, and which we have described under the name of *gynerium* *. Every hut is surrounded with enormous trees of persea †, at the foot of which the aristolochiæ, paullinia, and other creepers, vegetate. The neighbouring mountains, covered with forests, seem to spread humidity over the western extremity of the valley of Caraccas. We passed the night in a plantation of sugar-canes, before our arrival at Las Ajuntas. A square house ‡ contained nearly eighty negroes; they were lying on skins of oxen spread upon the ground. In each apartment of the house were four slaves; it looked like a barrack. A dozen fires were burning in the farm-yard, where people were employed in dressing victuals. We were again struck with the noisy mirth of the blacks, which almost prevented us from sleeping. The clouds hindered me from observing the stars; the Moon appeared only at intervals. The aspect of the landscape was dull and uniform, and all the surrounding hills were covered with aloes. Workmen were employed at a small canal, which was intended to convey the waters of the Rio San Pedro to the farm, at a height of more than seventy feet. According to a barometric calculation, the site of the *hacienda* is only fifty toises above the bed of the Rio Guayra at La Noria, near Caraccas.

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* *G. Saccharoides. Plant. æquin.*, vol. ii, tab. 115. *Nova Gener.*, vol. i, p. 149.

† *Laurus persea*, alligator pear.

‡ *Hacienda de Don Fernando Key-Munoz.*

The soil of these countries has been found but little favourable to the cultivation of the coffee-tree, which in general is less productive in the valley of Caraccas, than was imagined when the first plantations were made near Chacao. In order to form a general idea of the importance of this branch of commerce, we must remember, that the produce of the whole province of Caraccas in it's greatest prosperity, before the revolutionary wars of 1812, amounted to fifty or sixty thousand quintals of coffee. This quantity, almost equal to the produce of Guadaloupe and Martinico both together, must appear so much the more considerable, as it is only since 1784, that a respectable citizen, don Bartholomew Blandin, endeavoured to introduce this branch of culture on the coasts of Terra Firma. Mr. Depons, in his statistical account of the Capitania-general of Venezuela, having been able to give information respecting the state of commerce and agriculture only as far as the year 1804, it will not be uninteresting to add some documents more recent, and not less exact. The finest coffee-plantations are now found in the savannah of Ocumare, near Salamanca, and at Rincon, in the mountainous countries of Los Mariches, San Antonio Hatillo, and Los Budares. The coffee of the last three places, to the East of Caraccas, is of a superior quality; but the trees bear a smaller quantity, which is attributed to the height of the spot, and the coolness of the climate. The greater plantations of the province of Venezuela, as Aguacates, near Valençia, and Rincon, yield in good years a produce of three thousand quintals. In 1796 the total exportation of the province was only four thousand eight hundred quintals, and in 1804, ten thousand; yet it began in 1789 *. The

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* I obtained the following information from the custom-house at La Guayra :

prices varied from six to eighteen piastres per quintal. At the Havannah it has sunk as low as three piastres; but at this period, so disastrous for the planters, in 1810 and 1812, more than two millions of quintals of coffee, amounting in value to ten millions sterling, were accumulated in the warehouses of England *.

The extreme predilection entertained in this province for the culture of the coffee-tree is partly founded on the circumstance, that the berry can be preserved during a great number of years; whereas, notwithstanding every possible care, cacao spoils in the warehouses after ten or twelve months. During the long dissensions of the European powers, at a time when the metropolis was too weak to protect the commerce of the colonies, industry was directed in preference toward productions, of which the sale was less urgent, and could wait the chances of political, and commercial events. I remarked, that, in the coffee-plantations, the nurseries are formed not so much by collecting together those young plants, which accidentally rise under trees that have yielded a crop, as by exposing

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Exportation of 1789—— 233 quintals, each 100lbs of Castille.
1792——1489
1794——3646
1796——4847
1797——3095

* *Colquhoun on the Wealth of the British Empire,* 1814, p. 332.

the seeds of coffee to germination during five days, in heaps between plantain leaves. These seeds are taken out of the pulp, but yet retaining a part of it adherent to them. When this seed has germinated, it is sown, and produces plants, that can bear the ardour of the Sun better than those, that spring up in the shade in the coffee-plantations. In this country five thousand three hundred coffee-trees are generally planted in a *vanega* of ground, amounting to five thousand four hundred and seventy-six square toises *. This land, if it be capable of artificial irrigation, costs five hundred piastres in the northern part of the province. The coffee-tree bears flowers only the second year, and it's flowering lasts only twenty-four hours. At this time the shrub has a charming aspect; seen from afar, it appears covered with snow. The produce of the third year becomes very abundant. In plantations well weeded and watered, and recently cultivated, we find trees bearing sixteen, eighteen, and even twenty pounds of coffee. In general however, a produce of more than a pound and half or two pounds cannot be expected from each plant; and even this is superior to the mean produce of the West India islands. Rains at the time of flowering, the want of water for artificial irrigations, and a parasitic plant, a new species of loranthus, which clings to the branches, are extremely injurious to the coffee-trees. When, in plantations of eighty or a hundred thousand shrubs, we consider the immense quantity of organic matter contained in the pulpy berry of the coffee-tree, we may be astonished, that no attempts have been made to extract a spirituous liquor from them *.

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* One *vanega* of Caraccas and Cumana contains nearly three *almudas*, or 28900 *square varas*, equal to 20754 square metres. One vanega consequently is nearly equivalent to two hectares. A legal French acre of 1344 square toises, which produces in Europe, in land of a middling quality, 1200 pounds of corn, or 3000 pounds of potatoes, is a quarter of a vanega, and would produce, under the torrid zone, near 1700 pounds of coffee in a year.

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* The berries heaped together produce a vinous fermentation, during which a very pleasant alcoholic smell is emitted. Placing at Caraccas the ripe fruit of the coffee-tree under an inverted jar, quite filled with water, and exposed to the rays of the Sun, I remarked, that no extrication of gas took place in the first twenty-four hours. After thirty-six hours the berries became brown, and yielded gas. A thermometer, enclosed in the jar in contact with the fruit, kept at night 4° or 5° higher than the external air. In the space of eighty-seven hours, sixty berries, under various jars, yielded me from thirty-eight to forty cubic inches of a gas, which underwent no sensible diminution with nitrous gas. Though a great quantity of carbonic acid had been absorbed by the water, as it was produced, I still found 0·78 in the forty inches. The remainder, or 0·22, was nitrogen. The carbonic acid had not been formed by the absorption of the atmospheric oxygen. That which is evolved from the berries of

If the troubles of St. Domingo, the augmentation for a time of the price of colonial produce, and the emigration of French planters, were the first causes of the establishment of coffee-plantations on the continent of America, in the island of Cuba, and in Jamaica; their produce has far more than compensated the deficiency of the exportation from the French West India islands. This produce has augmented in proportion to the population, the change of customs, and the increasing luxury of the nations of Europe. The island of St. Domingo exported in 1780, in the time of Mr. Necker, near seventy-six millions of pounds * of coffee. The exportation in 1812 and the three preceding years still amounted, according to the researches of Mr. Colquhoun, to thirty-six mil-

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the coffee-tree slightly moistened, and placed in a vial with a glass stopple filled with air, contains alcohol in suspension; nearly as the foul air, which is formed in our cellars during the fermentation of must. On agitating the gas in contact with water, the latter acquires a decidedly alcoholic flavour. How many substances are perhaps contained in a state of suspension in those mixtures of carbonic acid and hydrogen, which are called *deleterious miasmata*, and which rise every where under the tropics, in marshy grounds, on the shores of the sea, in the forests where the soil is strewed with dead leaves, rotten fruits, and putrefying insects!

* Always French pounds, containing 9216 grains. 112 English pounds = 105 French pounds; and 110 Spanish pounds = 93 French pounds.

lions*. The cultivation of the coffee-tree, less fatiguing, and less expensive, than that of the sugar-cane, has not suffered so much from the domination of the blacks. The deficiency of forty millions of pounds is at present replaced by

26,500,000	pounds produce of Jamaica.
20,000,000	——— produce of Cuba.
11,400,000	——— produce of Surinam, Demerara, Berbice, and Curasoa.
5,000,000	——— produce of Venezuela.
13,000,000	——— produce of Java †.
75,900,000	pounds.

The total exportation of coffee from America to Europe now exceeds one hundred and six millions of pounds (French *poids de marc)*. If we add to this quantity four or five millions from the Isles of France and Bourbon, and thirty millions from Arabia and Java, we shall find the whole consumption of Europe* in 1817 was not far from one hundred and forty millions of pounds. In the inquiries I made concerning colonial produce in 1810, I fixed on a smaller quantity †. This enormous consumption of coffee has not diminished that of tea, the exportation of which from China has augmented more than one fourth in the last fifteen years ‡. Tea could be cultivated as well as coffee in the mountainous parts of the provinces of Caraccas and Cumana. Every climate is there found rising in stages one above another; and this new culture would succeed there as well as in the southern hemisphere, where the government of Brazil, nobly protecting at the same time industry and religious toleration, suffered at once the introduction of tea, of the Chinese, and of the dogmas of Fo. It is not yet a century since the first coffee-trees were planted at

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* The exportation from St. Domingo to the English ports alone amounted from 1809 to 1811, one year with another, to 19,364,666 English pounds of coffee. *Colquhoun*, p. 331 and 378. Produce of the Caribbee islands fourteen millions of pounds. Produce of Cuba, in 1809 alone, 80,000 quintals.

† More than 100,000 *pikuls*, at 133 pounds each. Mr. von Hogendorp thinks, that the island of Java, in it's present state of civilization, but by means not very philanthropic, could furnish Europe with fifty millions of pounds of coffee. *Raffle's Hist. of Java*, vol. i, p. 129 and 213.

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* The consumption of France is generally estimated (rather high) at twenty-three millions of pounds. But the population of France is about one sixth of that of all Europe.

† *Essai polit. sur le Mexique*, vol. ii, p. 435.

‡ The exportation of tea from Canton, from 1804 to 1806, was on a mean 260,000 *pikles*, or thirty-one millions of pounds annually. The consumption of Great Britain exceeds twenty millions. See as above, vol. ii, p. 658; and *Colquhoun*, p. 334; *Appendix*, p. 8, 26, 34.

Surinam, and in the West India islands, and already the produce of America amounts to fifteen millions of piastres, reckoning the quintal of coffee at fourteen piastres only.

On the eighth of February we set out at sunrise, to cross Higuerota, a group of lofty mountains, which separate the two longitudinal valleys of Caraccas and Aragua. After having passed, near Las Ajuntas, the junction of the two small rivers San Pedro and Macarao, which form the Rio Guayra, we ascended a steep hill to the table-land of La Buenavista, where we saw a few lone houses. The view extends on the North-West to the city of Caraccas, and on the South to the village of Los Teques. The country has a savage aspect, and is thickly wooded. We had gradually lost the plants of the valley of Caraccas *. We were eight hun-

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* The Flora of Caraccas is characterized chiefly by the following plants, which grow between the heights of four hundred and six hundred toises. Apura martinicensis, panicum *micranthum*, parthenium hysterophorus, vernonia *odoratissima* (pevetera, the flowers of which have a delicious smell of heliotropium), tagetes *caracasana*, t. *scoparia* of Lagasca (introduced by Mr. Bonpland into the gardens of Spain), croton *hispidus*, smilax *scabriusculus*, limnocharis *humboldti* Rich., equisetum *ramosissimum*, heteranthera alismoïdes, glycine *punctata*, hyptis Plumeri, pavonia cancellata Cav., spermacoce *rigida*, crotalaria *acutifolia*, polygala *nemorosa*, stachytarpheta mutabilis, cardiospermum *ulmaceum*, amaranthus *caracasanus*, elephantopus strigosus, hydrolea *mollis*, alter-

dred and thirty-five toises above the level of the ocean, which is almost the height of Popayan; but the mean temperature of this place is probably only 17° or 18°*. The road over these mountains is much frequented; we met at every step long files of mules and oxen; it is the great road leading from the capital to Victoria, and the valleys of Aragua. The road is cut out of a talcose gneiss† in a state of de-

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santhera *caracasana*, eupatorium *amydalinum*, elytraria *fasciculatu*, salvia *fimbriata*, angclonia *salicaria*, heliotropium *strictum*, convolvulus *batatilla*, rubus jamaicensis, datura arborea, dalea enneaphylla, buchnera *rosea*, salix *humboldtiana* Willd., theophrasta longifolia, tournefortia *caracasana*, inga *cinerea*, i. lignstrina, i. sapindioides, i. fastuosa, schwenkia patens, erythrina *mitis*. The most agreeable places for herborizations near Caraccas are the ravines of Tacagua, Tipe, Cotecita, Catoche, Anauco, and Chacaito. (With respect to plants that grow between the heights of 800 and 1300 toises on the *Silla*, in the region of the befarias, the trixis nereifolia, and the myrica caracasana, see above, chap. xiii, vol. iii, p. 494—505.) In the four works of descriptive botany, which we have published, the *Plantes Equinoxiales*, the *Monographie des Rhexia*, that of the *Melastomes*, and the *Nova Genera*, the plants of the different parts of Spanish America are collected and arranged in natural families; in this *Personal Narrative* I endeavour to bring together what belongs to the same place, not in order to give a Flora, but to enable the botanical reader to form an idea of the physiognomy of the country, and the aspect of vegetation.

* From 13·6° to 14·4° Reaumur.

† The direction of the strata of gneiss varies; it is either hor. 3·4, dipping to the N. W. or hor. 8·2, dipping to the S. E.

composition. A clayey soil mixed with spangles of mica covered the rock, to the thickness of three feet. Travellers suffer from the dust in winter, while in the rainy season the place is changed into a slough. On descending the table-land of Buenavista, about fifty toises toward the South-East, an abundant spring, gushing from the gneiss, forms several cascades surrounded with the thickest vegetation. The path leading to the spring is so steep, that we could touch with our hands the tops of the arborescent ferns, the trunks of which reach a height of more than twenty-five feet. The surrounding rocks are covered with jungermannias and hypnoid mosses. The torrent, formed by the spring, and shaded with heliconias *, uncovers, as it falls, the roots of the plumerias †, cu-

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* Mr. Bredemeyer, who has in his possession valuable manuscripts on the plants of Caraccas, has described a musaceous plant under the name of heliconia caasupa. It grows only in very temperate or cold places. We know not whether it be the species of the Silla (see chap. xiii, vol. iii, p. 501), for Messrs. Bredemeyer and Bose did not reach the summit of that mountain, or see the befarias of so elevated a region.

† The red jessamine-tree, *frangipanier* of the French West India islands. The plumeria, so common in the gardens of the Indians, has been very seldom found in a wild state. It is mixed here with the piper *flagellare*, the spadix of which sometimes reaches three feet long. With the new kind of fig-tree, which we have called ficus *gigantea* (*Nov. Genera,*

pevs*, browneas, and ficus *giganteas*. This humid spot, infested by serpents, presents a rich harvest to the botanist. The brownea, which the inhabitants call *rosa del monte*, or *palo de Cruz*, bears four or five hundred purple flowers together in one thyrsis; each flower has invariably eleven stamina, and this majestic plant, the trunk of which reaches the height of fifty or

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vol. ii, p. 48), because of it's attaining the height sometimes of a hundred feet, we find in the mountains of Buenavista, and of Los Teques, the ficus nymphæifolia of the garden of Schoenbrun, introduced into our hot-houses by Mr. Bredemeyer. I am certain of the identity of the species found in the same places; but is it really the f. nymphæifolia of Linneus, which is supposed to be a native of the East Indies? This I doubt.

* In the experiments which I made at Caraccas, on the air that circulates in plants, I was struck with the fine spectacle, which the petioles and leaves of the clusea rosea display, when slit open under water, and exposed to the rays of the Sun. Each trachea gives out a current of gas, which is purer by 0·08 than atmospheric air. The phenomenon ceases, the moment the apparatus is placed in the shade. There is also but a very slight disengagement of air at the two surfaces of the leaves of the clusia exposed to the Sun without being slit open. The gas inclosed in the capsules of the cardiospermum *vesicarium* appeared to me to contain the same proportion of oxygen as the atmosphere, while that contained between the knots, in the hollow of the stalk, is generally less pure, containing only from 0·12 to 0·15 of oxygen. It is necessary to distinguish between the air circulating in the tracheæ, and that which is stagnant in the great cavities of the stems and pericarps.

sixty feet, is becoming rare, because it's wood yields a highly valued charcoal. The soil is covered with pine-apples, hemimeris, polygala, and melastomas. A climbing gramen* unites together with it's light festoons trees, the presence of which attests the great coolness of the climate of these mountains. Such are the aralia capitata†, the vismia caparosa, and the clethra fagifolia. Amid these plants, peculiar to the fine region of the arborescent ferns *(region de los helechos)* some palm-trees rise in the openings, and some scattered groups of *guarumo* or cecropia with silvery leaves, the trunks of which, of small thickness, are of a black colour toward the summit, as if they had been burnt by the oxygen of the atmosphere. We are surprised to find so noble a tree, which has the port of the theophrasta and the palm-tree, bearing generally only eight or ten terminal leaves. The ants, that inhabit the trunk of the *guarumo*, or *jarumo*, and destroy the interior cells, seem to impede it's growth. We had already made one herborization in the temperate mountains of Higuerota, in the month of December, accompanying the capitania-general, Mr. de Guevara, in an excursion with the intendant of the province to the *Valles de Aragua*. Mr. Bonpland then found in the thickest part of the forest some plants of aguatire, the wood of which, celebrated for it's fine red colour, may one day become an article of exportation to Europe. It is the sickingia erythroxylon described by Messrs. Bredemeyer and Willdenow.

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* *Carice.* See vol. iii, p. 17.

† *Candelero.* We found it also at la *Cumbre*, at a height of 700 toises.

Descending the woody mountain of Higuerota toward the South-West, we reached the small village of San Pedro *, situate in a basin, where several valleys meet, and which is almost three hundred toises lower than the table-land of Buenavista. Plantain-trees, potatoes †, and coffee were cultivated together on that spot. The village is very small, and the church was not yet finished. We met at an inn *(pulperia)* several European Spaniards employed at the tobacco office. Their ill humour formed a singular contrast with our disposition. Fatigued with the road, they vented their displeasure in complaints and maledictions against the wretched country *(estas tierras infelices)*, where they were doomed to live; while we were never wearied of admiring the wild scenery that surrounded us, the fertility of the soil, and the mildness of the climate. Near San Pedro, the talcose gneiss of Buenavista passes into a mica-slate filled with garnets, and containing subordinate beds of serpentine. This situation has some analogy with that of Zœblitz in Saxony. The serpentine, very pure and of a fine green, varied with spots of a lighter tint, often appears only superimposed on the mica-slate. I found in it a few garnets, but no metalloid diallage.

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* Absolute height, 584 toises.

† Solanum tuberosum.

The valley of San Pedro, through which flows the river of the same name, separates two great masses of mountains, Higuerota and Las Cocuyzas. We ascended toward the West by the small farms of Las Lagunetas and Garavatos. These are only solitary houses, which serve as inns, and where (the mule-drivers find their favourite beverage, the *guarapo*, or fermented juice of the sugar-cane; intoxication is very common among the Indians who frequent this road.) Near Garavatos there is a mica-slate rock of a singular form, that of a ridge, or steep wall, crowned by a tower. We opened the barometer at the highest point * of the mountain Las Cocuyzas, and found ourselves almost at the same elevation as on the table-land of Buenavista, which is scarcely ten toises higher.

The prospect at Las Lagunetas is extensive, but rather uniform. This mountainous and uncultivated ground between the sources of the

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* Absolute height 845 toises.

Guayra and the Tuy is more than twenty-five square leagues. We there found only one miserable village, that of Los Teques, to the South-East of San Pedro. The soil is in some sort furrowed by a multitude of valleys, the smallest of which, parallel with each other, terminate at a right angle in the largest valleys. The back of the mountains is of an aspect as monotonous as the ravines; it has no pyramidal forms, no ridges, no steep declivities. I am inclined to think, that the undulation of this ground, for the most part gentle, is less owing to the nature of the rocks, to the decomposition of the gneiss for instance, than to the long abode of water, and the action of currents. The limestone mountains of Cumana exhibit the same phenomenon to the North of Tumiriquiri *.

From Las Lagunetas we descended into the valley of the rio Tuy. This western slope of the mountains of Los Teques bears the name of Las Cocuyzas; it is covered with two plants with agave leaves; the *maguey of Cocuyza*, and the *maguey of Cocuy*. The latter belongs to the genus *yucca* †. It's sweet and fermented juice yields a spirit by distillation; and I have seen the young leaves of this plant eaten. The fibres of the full-grown leaves furnish cords of extraordinary strength*. Leaving the mountains of Higuerota and Los Teques, we entered a highly cultivated country, covered with hamlets and villages; several of which would in Europe be called towns. From East to West, on a line of twelve leagues, we passed La Victoria, San Matheo, Turmero, and Maracay, containing together more than 28,000 inhabitants. The plains of the Tuy may be considered as the eastern extremity of the valleys of Aragua, extending from Guigne, on the borders of the lake of Valencia, as far as the foot of Las Cocuyzas. A barometrical measurement gave me 295 toises for the absolute height of the *Valle del Tuy*, near the farm of Manterola, and 222 toises for that of the surface of the lake. The Rio Tuy, flowing from the mountains of Las Cocuyzas, runs first toward the West, then turning to the South, and to the East, it takes it's direction along the high savannahs of Ocumare, receives the waters of the valley of Caraccas, and reaches the sea near Cape Codera. It is the small portion of it's basin directed toward the West, that, geologically speaking, would seem to belong to the valley of Aragua, if the hills of calcareous tufa, which interrupt the continuity of these valleys between Consejo and La Victoria, did not deserve some consideration. We shall here again remind the reader, that the group of the mountains of Los Teques, eight hundred and fifty toises high, separates two *longitudinal valleys*, formed in gneiss, granite, and mica-slate; the easternmost of which, containing the capital of Caraccas, is 200 toises higher than the western valley, which may be considered as the centre of agricultural industry.

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* See chap. vi, vol. iii, p. 96.

† It is our yucca *acaulis, Nov. Gen.*, vol. i, p. 289.

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* At the clock of the cathedral of Caraccas, a cord of maguey, five lines in diameter, has sustained for fifteen years a weight of 350 pounds.

Accustomed for a long time to a moderate temperature, we found the plains of the Tuy extremely hot, although the thermometer kept in the day, between eleven in the morning and five in the afternoon, at only 23° or 24°. The nights were of delightful coolness, the temperature falling as low as 17·5° *. As the heat gradually abated, the air became more fragrant with the odour of flowers. We remarked above all the delicious perfume of the *lirio hermoso* †, a new species of pancratium, of which the flower, eight or nine inches long, adorns the banks of the Rio Tuy. We spent two very agreeable days at the plantation of don Jose de Manterola, who in his youth had accompanied the Spanish embassy to Russia. Brought up and patronised by

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* 14° Reaumur.

† Pancratium undulatum (*Nov. Gen.*, vol. i, p. 280).

Mr. de Xavedra, one of the most enlightened intendants of Caraccas, he was going to embark for Europe, when that celebrated statesman became minister. But the governor of the province, dreading the influence of Mr. de Monterola, caused him to be arrested in the port; and when orders arrived from the court to put an end to so arbitrary a confinement, that minister was already out of favour. At a distance of one thousand five hundred leagues from Equinoxial America, it is not easy to arrive in time to profit by the power of a man in place.

The farm we inhabited is a fine plantation of sugar-canes. The ground is as smooth as the bottom of a drained lake. The Rio Tuy winds among grounds covered with plantains, and a little wood of hura crepitans, erythrina corallodendron, and fig-trees with nymphea leaves. The bed of the river is formed of pebbles of quartz. I never met with more agreeable baths than those of the Tuy. The water, as clear as crystal, preserves even in the day a temperature of 18·6°; a considerable coolness for these climates, and for a height of three hundred toises; but the sources of the river are in the surrounding mountains. The house of the proprietor, situate on a hillock, of fifteen or twenty toises of elevation, is surrounded by the *casas* of the negroes. Those who are married provide food for themselves. Here, as every where else in the valleys of Aragua, a small spot of ground is allotted to them to cultivate; and where they labour on Saturdays and Sundays, the only days in the week that they are free. They keep poultry, and sometimes even a pig. Their masters boast of their happiness, as in the North of Europe the great landholders like to descant upon the ease which the peasants enjoy, who are attached to the glebe. The day of our arrival we saw three fugitive negroes brought back; they were slaves newly purchased. I dreaded having to witness one of those punishments, which, wherever slavery prevails, destroys all the charm of a country life. Happily these blacks were treated with humanity.

In this plantation, as in all those of the province of Venezuela, three species of sugar-cane can be distinguished even at a distance by the colour of their leaves; the ancient Creole sugar-cane, the Otaheite cane, and the Batavia cane. The first has a leaf of a deeper green; the stem less thick, and the knots nearer together. This sugar-cane was the first introduced from India into Sicily, the Canary Islands, and the West Indies. The second is of a lighter green; and it's stem is higher, thicker, and more succulent. The whole plant displays a more luxuriant vegetation. We owe this plant to the voyages of

Bougainville, Cook, and Bligh *. Bougainville carried it to the Isle of France, whence it passed to Cayenne, Martinique, and, since 1792, to the rest of the West India islands. The sugar-cane of Otaheite, the *to* of those islanders, is one of the most important acquisitions, for which colonial agriculture is indebted to the travels of naturalists. It yields not only one third more of juice than the creolian cane on the same space of land; but from the thickness of it's stem, and the tenacity of it's ligneous fibres, it furnishes much more fuel. This last advantage is important in the West Indies, where the destruction of the forests has for a long time obliged the planters to use the canes deprived of their juice, to keep up the fire under the boilers. But for the knowledge of this new plant, the progress of agriculture on the continent of Spanish America, and the introduction of the East Indian and Java sugar, the revolutions of St. Domingo, and the destruction of the great sugar plantations of that island, would have had a more sensible effect on the prices of colonial produce in Europe. The Otaheite sugar-cane was carried from the island of Trinidad † to Caraccas. From Caraccas it passed to Cucuta and San Gil in the kingdom of New Grenada *. In our days it's cultivation during twenty-five years has almost entirely removed the apprehension, which was at first entertained, that, transplanted to America, the plant would by degrees degenerate, and become as slender as the creole cane. If it be a variety, it is a very constant one. The third species, the violet sugar-cane, called *Cana de Batavia*, or *de Guinea*, is certainly indigenous in the island of Java, where it is cultivated in preference in the districts of Japara and Pasuruan †. It's foliage is purple and very broad; and it is preferred in the province of Caraccas for rum. The *tablones*, or grounds planted with sugar-canes, are divided by hedges of a colossal gramen; the *latta*, or gynerium with distich leaves. At the Tuy men were employed in finishing a dyke, to form a canal of irrigation. This enterprise had cost the proprietor seven thousand piastres for the expense of workmanship, and four thousand piastres for the costs of lawsuits in which he was engaged with his neighbours. While the lawyers were disputing about a canal, of which only one half was finished, Mr. de Manterola began to doubt even of the possibility of carrying the plan into execution. I took the level of the ground with a lunette d'epreuve, on an artificial horizon, and found, that the dam had been constructed eight feet too low. What sums of money have I seen expended uselessly in the Spanish colonies, for undertakings founded on erroneous levelling!

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* See my *Tableaux de la Nature*, tom. i, p. 74; *Nov. Genera*, tom. i, p. 181; and a note of Messrs. Thouin and Du Buc in the *Voyage à la Trinité*, vol. ii, p. 357—362.

† By the care of Messrs. Don Simon de Majora, Martin, Iriarte, Manuel Ayala, and Andres Ibarra.

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* Under the name of *Caña solera*. See a paper by D. Eloy de Valenzuela, incumbent of Bucaramanga, in the *Seman de Santa Fe*, tom. ii, p. 13.

† *Raffles, Hist. of Java*, tom. i, p. 124.

The valley of the Tuy has it's "gold mine," like almost every part of America inhabited by Whites, and backed by primitive mountains. I was assured, that, in 1780, foreign gold-gatherers were seen to pick up grains of that metal, and to establish a place for washing the sand in the ravine of the Oro. An overseer, or *major-domo*, of a neighbouring plantation, had followed these indications; and after his death, a waistcoat with gold buttons being found among his clothes, this gold, according to the logic of these people, could only have proceeded from a vein, which the falling-in of the earth had rendered invisible. In vain I objected, that I could not, by the mere view of the soil, without digging a large trench in the direction of the vein, well judge of the existence of the mine; I was compelled to yield to the desire of my hosts. For twenty years past the major-domo's waistcoat had been the subject of conversation in the country. Gold extracted from the bosom of the

Earth is far more alluring in the eyes of the vulgar, than that which is the produce of agricultural industry, favored by the fertility of the soil, and the mildness of the climate.

To the North-West of the Hacienda del Tuy, in the northern range of the chain of the coast, we find a deep ravine, called *Quebrada Seca*, because the torrent, by which it was formed, loses it's waters through the crevices of the rock, before it reaches the extremity of the ravine. The whole of this mountainous country is covered with a thick vegetation. We there found the same verdure as had charmed us by it's freshness in the mountains of Buenavista and Las Lagunetas, wherever the ground rises as high as the region of the clouds, and where the vapours of the sea have free access. In the plains, on the contrary, as we have observed above, many trees are stripped of a part of their leaves during the winter; and when we descend into the valley of the Tuy, we are struck with the almost hybernal aspect of the country. The dryness of the air is such, that the hygrometer of Deluc * keeps day and night between 36° and 40°. Far from the river we scarce find a few huras or piper trees extend their foliage over thickets destitute of verdure. This phenomenon seems owing to the dryness of the air, which attains it's maximum in the month of February; and not, as the European planters assert, "to the seasons of Spain, of which the empire extends as far as the torrid zone." It is only plants transported

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* The following is a series of hygrometrical observations, which I made in the valleys of the Tuy and Aragua, in the shade, the whalebone hygrometer having been carefully reduced to the point of extreme humidity. *Hacienda de Monterola* (altitude 295 toises). On the 11th of February, at 1 o'clock; hygr. 36·8°, therm. cent. 26·6°: at 4; hygr. 34·7°, th. 27·5°: at 12 (midnight), hygr. 38·8°, th. 22·5°

The 12th of Feb., at 22 in the morning, hygr. 37·8°, th. 25° : at 3, hygr. 35°, th. 26·2°: at 11, hygr. 42·6°, th. 21·2°: *Hacienda de Cura* (altitude 226 toises). The 14th of Feb. at 2, hygr. 35·2°, th. 27·5°: at 4, hygr. 34°, th. 28·1°: at 5^h 30′, hygr. 34·2°, th. 26·3°: at 7, hygr. 36·7°, th. 25°: at 12, hygr. 39·5°. On the 15th of Feb. at 2^h 30′, hygr. 34·2°, th. 25°: at 11, hygr. 37·6°, th. 23·7°. The 16th of Feb. at 18, hygr. 38·5°, th. 20°: at 21, hygr. 39·7°, th. 23·3°: at 3^h 30′, hygr. 35·2°, th. 26·2°: at 9, hygr. 37·6°, th. 23·3°: at 11, hygr. 38·6°, th. 22·7°. The 17th of Feb. at 19, hygr. 39·6°, th. 21·2°: at 1, hygr. 35·2°, th. 26·3°: at 12, hygr. 37·4°, th. 22·6°. The 19th of Feb. at 4, hygr. 34°, th. 25·2°: at 12, hygr. 38·7°, th. 22·5°. During all these observations the sky was clear, and without clouds. The *mean humidity* of the month of February appeared to have been in the valleys of Aragua, 35°—36° of Deluc, or 70·8°—72° of Saussure, with a mean temperature of 24·3°. These numbers indicate a considerable dryness, if we recollect the usual state of the hygrometer between the tropics. (See chap. iii, vol. ii, p. 88—90.) At Paris, and at Geneva, the humidity of the months, the mean temperature of which reaches 18°, is above 82° of Saussure.

from one hemisphere to the other, which, in their organic functions, in the developement of their leaves and flowers, still retain their relations to a distant climate; and, faithful to their habits, follow for a long time it's periodical changes. In the province of Venezuela the trees stripped of their foliage begin to renew their leaves nearly a month before the rainy season. It is probable, that at this period the electrical equilibrium of the air is already disturbed, and the atmosphere, although not yet clouded, becomes gradually more humid. The azure of the sky is paler, and the elevated regions are loaded with light vapours, uniformly diffused. This season may be considered as the awakening of nature; it is a spring, which, according to the received language of the Spanish colonies, proclaims the beginning of winter, and succeeds to the heats of summer *.

Indigo was formerly cultivated in the Quebrada Seca; but as the soil covered with vegetation cannot there concentrate so much heat as the plains and the bottom of the valley of the Tuy receive and radiate, the cultivation of coffee has been substituted in it's stead. As we ad-

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* That part of the year most abundant in rain is called winter; so that in Terra Firma the season, which begins by the winter solstice, is designated by the name of summer; and it is usual to hear, that it is *winter* on the mountains, at the time when *summer* prevails in the neighbouring plains.

vanced in the ravine we found the moisture increase. Near the Hato, at the northern extremity of the Quebrada, a torrent gushes down on sloping beds of gneiss. An aqueduct was there forming, to convey the water to the plain. Without irrigation, the progress of agriculture is null in these climates. A tree of monstrous size fixed our attention *. It lay on the slope of the mountain, above the house of the Hato. At the least sinking of the earth, it's fall would have crushed the habitation which it shaded: it had therefore been burnt near it's foot, and cut down in such a manner, that it fell between some enormous fig-trees, which prevented it from rolling into the ravine. We measured the fallen tree; and though it's summit had been burnt, the length of it's trunk was still one hundred and fifty-four feet †. It was eight feet in diameter near the roots, and four feet two inches at the upper extremity.

Our guides, less anxious than ourselves to measure the bulk of trees, continually pressed us to proceed, and seek for the "gold mine." This part of the ravine, little frequented, is not uninteresting. We made the following observations on the geological constitution of the soil. At the entrance of the Quebrada Seca we re-

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* Hura crepitans.

† French measure, nearly fifty metres.

marked great masses of primitive saccharoidal limestone, tolerably fine grained, of a bluish tint, and traversed by a great number of veins of calcareous spar of a dazzling whiteness. These calcareous masses must not be confounded with the very recent depositions of tufa, or carbonat of lime, that fill the plains of the Tuy; they form beds of mica-slate, passing into a talc-slate *. The primitive limestone often simply covers this latter rock in *concordant stratification* †. Very near the *hato* the talcose slate becomes entirely white, and contains small layers of soft and unctuous graphic ampelite ‡. Some pieces, destitute of veins of quartz, are a real granular graphite, which might be of use in the arts. The aspect of the rock is very singular in those places, where thin plates of black ampelite alternate with thin, sinuous, and satiny plates of a talcose slate white as snow. It would seem as if the carbon and iron, which in other places colour the primitive rocks, are here concentrated in the subordinate strata.

Turning toward the West we reached at length the ravine of gold *(Quebrada del Oro)*. We hardly recognized the vestige of a vein of quartz on the slope of a hill. The falling down of the earth caused by the rains had changed the surface of the ground, and rendered it impossible to make any observation. Great trees were growing in the same places, where the gold-washers had worked twenty years before. It is probable, that the mica-slate contains here, as near Goldcronach in Franconia, and in the country of Saltzbourg, auriferous veins; but how is it possible to judge whether this vein be worth the expense of being wrought, or whether the ore occur only in nodules, and in less abundance in proportion as it is so rich? In order to derive some advantage from our fatigues, we made a long herborization in the thick forest, that extends beyond the *hato*, and abounds in cedrelas, browneas, and fig-trees with nymphea leaves. The trunks of these last are covered with very odoriferous plants of vanilla, which in general flower only in the month of April. We were here again struck with those ligneous excrescences, which in the form of ridges, or ribs, augment in so extraordinary a manner, and as far as twenty feet above the ground, the thickness of the trunk of the fig-trees of America. I found trees twenty-two feet and half in diameter near the roots. These ligneous ridges sometimes separate from the trunk at a height of eight feet, and are transformed into cylindrical roots two feet thick. The tree looks as if it were supported by buttresses. This scaffolding however does not penetrate very deep into the earth. The lateral roots wind at the surface of the ground, and when at twenty feet distance from the trunk they are cut with a hatchet, we see the milky juice of the fig-tree gush out, which, when deprived of the vital influence of the organs of the tree, is altered and coagulates. What a wonderful combination of cells and vessels exists in these vegetable masses, in these gigantic trees of the torrid zone, which without interruption, perhaps during a thousand years, prepare nutritious fluids, raise them to the height of one hundred and eighty feet, convey them down again to the ground, and conceal beneath a rough and hard bark, under the inanimate layers of ligneous matter, all the movements of organic life!

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* Real *talkschiefer* of Werner, without garnets or serpentine, not eurite or *weisstine*. It is rather in the mountains of Buenavista, that the gneiss manifests a tendency to pass into eurite.

† Direction hor. 3·5°; dip 70° South-East.

‡ *Zeichenschiefer*.

I availed myself of the clearness of the nights, to observe at the plantation of Tuy two emersions of the first and third satellites of Jupiter. These two observations gave, according to the tables of Delambre, long. 4h 39′ 14″; and by the chronometer I found 4h 39′ 10″. These are the last occultations I observed before my return from the Oroonoko; they served to fix with some accuracy the eastern extremity of the valleys of Aragua, and the foot of the mountains of Los Cocuyzas. I found by meridian altitudes of Canopus the latitude of the *Hacienda de Manterola*, on the 9th of February, 10° 16′ 55″; the 10th of February, 10° 16′ 34″. Notwithanding the extreme dryness of the air, the stars twinkled even at altitudes of 80°; a very rare phenomenon in this zone, and which perhaps announced the end of the fine season. The dip of the needle was 41·6° (cent. div.); and 228 oscillations in ten minutes time indicated the intensity of the magnetic power. The variation of the needle was 4° 30′ North-East. During my stay in the valleys of Tuy and Aragua, the zodiacal light appeared almost every night with extraordinary brilliancy. I had perceived it for the first time between the tropics at Caraccas, on the 18th of January, after seven in the evening. The point of the pyramid was at the height of 53°. The light totally disappeared at 9h 35′ (apparent time), nearly 3h 50′ after sunset, without any diminution in the serenity of the sky*. La Caille, in his voyage to Rio Janeiro and the Cape, had already been struck with the beautiful appearance displayed by the zodiacal light between the tropics, not so much on account of it's less inclined position, as of the greater transparency of the air *. It would appear singular, that long before Childrey and Dominic Cassini, the navigators who frequented the seas of the two Indies had not directed the attention of the philosophers of Europe toward this light, of a regular form and progress, if we did not know how little, till the middle of the eighteenth century, mariners were interested by any thing, that had not an immediate relation to the course of the ship, and the demands of navigation.

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* On the 15th of February, the total disappearance took place 2h 50′ after sunset. Altitude of the pyramid, 50° above the horizon.

However brilliant the zodiacal light in the dry valley of Tuy, I have observed it more beautiful still at the back of the Cordilleras of Mexico, on the banks of the lake of Tezcuco, eleven hundred and sixty toises above the surface of the ocean. On this table-land, the hygrometer of Deluc goes back as far as 15° †; and under 21 inches eight lines of barometrical pressure the extinction of light is $\frac{1}{1000}$ weaker than on the plains. In the month of January, 1804, the light rose sometimes to more than 60° above the horizon. The Milky Way appeared

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* It was the great serenity of the air, that caused this phenomenon to be remarked, in 1668, in the arid plains of Persia.

† To 42·8°, Sauss., at the temperature of 23·4° cent. therm.

to grow paler compared with the brilliancy of the zodiacal light; and if small, bluish, scattered clouds were accumulated toward the West, it seemed as if the Moon were going to rise.

I must here relate another very singular fact, which is several times noted in my private journal written on the spot. On the 18th of January, and the 15th of February, 1800, the intensity of the zodiacal light changed in a very perceptible manner, at intervals of two or three minutes. Sometimes it was very faint, at others it surpassed the brilliancy of the Milky Way in Sagittarius. The changes took place in the whole pyramid, especially toward the interior, far from the edges. During these variations of the zodiacal light, the hygrometer indicated a considerable dryness. The stars of the fourth and fifth magnitude appeared constantly to the naked eye with the same degree of light. No stream of vapour was visible, nothing seemed to alter the transparency of the atmosphere. In other years I saw the zodiacal light augment in the southern hemisphere half an hour before it's disappearance. Dominic Cassini admitted *, "that the zodiacal light was feebler in certain years, and then returned to it's former brilliancy." He thought, that these slow changes

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* *Mém. de l'Académie*, vol. viii, p. 164 and 208.

were connected with "the same emanations, which render the appearance of spots and faculæ periodical on the solar disk." But this excellent observer does not mention those changes of intensity in the zodiacal light, which I have several times remarked between the tropics, in the space of a few minutes. Mairan * asserts, that in France it is common enough to see the zodiacal light, in the months of February and March, mingling with a kind of Aurora Borealis, which he calls *undecided*, and the nebulous matter of which spreads itself all around the horizon, or appears toward the West. I very much doubt, that, in the observations I have been relating, there was any mixture of these two species of light. The variations in intensity took place at considerable altitudes; the light was white, and not coloured; tranquil, and not undulating. Besides, the Aurora Borealis is so seldom visible between the tropics, that, during five years, though almost constantly sleeping in the open air, and observing with unremitting attention the vault of Heaven, I never perceived the least traces of this phenomenon.

Resuming the whole of what I find noted on my registers concerning the variations of the zodiacal light, I am rather inclined to think, that these variations are not all of them appearances dependant on certain modifications in the state of our atmosphere. Sometimes, during nights equally clear, I sought in vain for the zodiacal light, when the day before it had appeared with the greatest brilliancy*. Must we admit, that emanations, which reflect white light, and seem to have some analogy with the tail of comets, are less abundant at certain periods? The researches on the zodiacal light have acquired a new degree of interest, since geometricians have taught us, that we are ignorant of the real causes of this phenomenon. The illustrious author of *La Mécanique céleste* has shown, that the solar atmosphere cannot reach even the orb of Mercury; and that it could not in any case display the lenticular form †, which observations have attributed to the zodiacal light. We may also entertain the same doubts respecting the nature of this light, as with regard to that of the tail of comets. Is it in fact a reflected, or a direct light? It is to be hoped, that philosophical travellers, who may visit the Equinoctial regions, will provide themselves with instruments of polarization, calculated to solve this important question.

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* *Traité de l'Aurore Boreale*, (2d ed.) p. 112—166. *Mém. de l'Académie*, 1733, p. 482, *id*. 1734, p. 572.

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* Mairan had been struck with the same phenomenon in our climates. "I cannot pass unnoticed," he says, "that twice, in the month of April, I have not been able to discover toward the West the least trace of the zodiacal light, during weather which seemed most favourable for it's appearance, and at the hour and season, when this light is most visible. And what is also worthy of being remarked, it appeared on the morrow of each of these days, very brilliant and very extensive." *Mém. de l'Académie*, 1733, p. 483; and *Mairan, Traité de l'Aurore bor.*, (2d ed.) p. 263.

† *Syst. du Monde*, (4th ed.) p. 270.

We left the plantation of Manterola on the 11th of February, at sunrise. The road follows the smiling banks of the Tuy; the morning was cool and humid, and the air seemed embalmed by the delicious odour of the pancratium undulatum, and other large liliaceous plants. In our way to La Victoria, we passed the pretty village of Mamon, or of *Consejo*, celebrated in the country for a miraculous image of the Virgin. A little before we reached Mamon, we stopped at a farm belonging to the family of Monteras. A negress more than a hundred years old was seated before a small hut, constructed with earth and reeds. Her age was known, because she was a creole slave. She seemed still to enjoy very good health. "I hold her to the Sun" *(la tengo al sol)*, said her grand-son; "the heat keeps her alive." The means appeared to us rather violent, for the Sun darted it's rays almost perpendicularly. The nations with a brown skin, Blacks well seasoned, and Indians, attain a happy old age in the torrid zone. I have mentioned elsewhere the history of a native of Peru *, who died at the age of one hundred and forty-three years, after having been ninety years married.

Don Francisco Montera, and his brother, a young and enlightened ecclesiastic, accompanied us, in order to conduct us to their house at La Victoria. Almost all the families, with whom we had lived in friendship at Caraccas, the Ustarizes, the Tovars, and the Toroes, were assembled in the fine valleys of Aragua. Proprietors of the richest plantations, they contended with each other in whatever could render our stay agreeable. Before we plunged into the forests of the Oroonoko, we enjoyed once more all the advantages of an advanced civilization.

The road from Mamon to La Victoria runs toward the South and the South-West. We soon lost sight of the river Tuy, which, turning to the East, forms an elbow at the foot of the high mountains of Guayraima. As we drew nearer to Victoria, the ground became smoother; it looked like the bottom of a lake, the waters of which had been drained off. We might have fancied ourselves in the valley of Hasli, in the canton of Berne. The neighbouring hills, only one hundred and forty toises in height, are composed of calcareous tufa; but their abrupt

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* Hilario Pari de Chiguata.

declivities project like promontories on the plain. Their form indicates the ancient shore of the lake. The eastern extremity of this valley is parched and uncultivated. No advantage has been derived from the ravines, that water the neighbouring mountains; but a fine cultivation is commencing in the proximity of the town. I say of the town, though in my time Victoria was considered only as a village *(pueblo)*.

We do not easily accustom ourselves to the idea of a village with seven thousand inhabitants, fine edifices, a church decorated with doric columns *, and all the resources of commercial industry. The inhabitants of Victoria had long demanded of the court of Spain the title of *villa*, and the right to choose a *cabildo*, a municipality. The Spanish ministry opposed their request, though at the expedition of Iturriaga and Solano to the Oroonoko, the pompous title of *ciudad*, city, had been granted, at the earnest solicitations of the monks of St. Francis, to a few groups of Indian huts. The municipal government, according to it's nature, ought to be one of the principal bases of the liberty and equality of the citizens; but in the Spanish colonies it has degenerated into a municipal aristocracy. Those who exercise an absolute power, instead of availing themselves skilfully of the influence of a few powerful families, dread what they call the spirit of independance of small boroughs. They prefer leaving the body of the state without strength and animation, to favouring those centres of action which escape their influence, and to keeping up that partial life which animates the whole mass, because it emanates rather from the people, than from the supreme authority. In the time of Charles V and Philip II the institution of municipalities was wisely protected by the court. Powerful men, who had acted a part in the conquest, laid the foundation of towns, and formed the first *cabildos*, in imitation of those of Spain. An equality of rights then existed between the men of the mother country and their American descendants. Politics, without being frank, were less suspicious than at present. The continent, recently conquered and ravaged, was considered as a distant Spanish possession. The idea of a colony, in the sense annexed to it in our days, developed itself only with the modern system of commercial policy; and this policy, while it recognized the real sources of national wealth, soon became narrow, mistrustful, and exclusive. It prepared the disunion between the colonies and the mother-country; it established among the whites an inequality, which had not been fixed by the first legislature of the Indies. The concentration of powers gradually weakened the influence of the municipalities; and these same *cabildos*, that in the 16th and 17th centuries * had the privilege of governing the country *per interim* after the death of a governor, were considered by the court of Madrid as dangerous shackles on the royal authority. From that time the richest villages, notwithstanding their rising population, obtained with difficulty the title of a town, and the right of governing themselves. Hence it results, that the recent changes in colonial politics have not all been in favour of philosophy. We may be convinced of this by looking over the laws of the Indies †, as far as they concern the Spaniards who have migrated to America and their descendants, the rights of communities, and the establishment of municipalities.

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* It was not finished, notwithstanding that the work had been going on for five years.

The environs of La Victoria present a very remarkable aspect, with regard to agriculture. The height of the cultivated ground is from two hundred and seventy to three hundred toises above the level of the ocean, and yet we there find fields of corn mingled with plantations of sugar-canes, coffee, and plantains. Excepting the interior of the island of Cuba*, we scarcely find any where else in the equinoctial regions European corn cultivated in large quantities in so low a region. The fine fields of wheat in Mexico are between six hundred and twelve hundred toises of absolute elevation; and it is rare to see them descend to four hundred toises. We shall soon perceive, that the produce of grain augments sensibly, from high latitudes toward the Equator, with the mean temperature of the climate, in comparing spots of different elevations. The success of agriculture depends on the dryness of the air; on the rains distributed among different seasons, or accumulated in one rainy season; on winds blowing constantly from the east, or bringing the cold air of the North into very low latitudes, as in the gulf of Mexico; on mists, which for whole months diminish the intensity of the solar rays; in short, on a thousand local circumstances, which have less influence on the mean temperature of the whole year, than on the distribution of the same quantity of heat among the different parts of the year. It is a striking spectacle, to see the grain of Europe cultivated from the Equator as far as Lapland, in the latitude of 69°, in regions where the mean heat is from 22° to —2°, in every place where the temperature of summer is above 9° or 10°. We know the minimum of heat requisite to ripen wheat, barley, and oats; we are less certain in respect to the maximum, which these species of grain, accommodating as they are, can support. We are even ignorant of all the circumstances, which favor the culture of corn between the tropics at very small heights. La Victoria and the neighbouring village of San Matheo yield an annual produce of four thousand quintals of wheat. It is sown in the month of December, and the harvest is reaped on the seventieth or seventy-fifth day. The grain is large, white, and abounding in gluten: it's pellicle is thinner and not so hard as that of the wheat of the very cold table-lands of Mexico. An acre* near Victoria generally yields from three thousand to three thousand two hundred pounds weight of wheat. The average produce is consequently here, as at Buenos Ayres, three or four times as much as that of northern countries. Nearly sixteen times the quantity of the seed is reaped; while, according to Lavoisier, the surface of France yields on a mean only five or six for one; or from one thousand to twelve hundred pounds per acre. Notwithstanding this fecundity of the soil, and this happy influence of the climate, the culture of the sugar-cane is more productive in the valleys of Aragua, than that of corn.

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* *Cedulas reales* of 1560, and 1675.

† *Leyes de Indias*, the most ancient.

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* The district of *Quatro Villas*.

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* An *arpent des eaux et forêts*, or legal acre of France, of which 1·95 = 1 hectare. It is about 1¼ acre English.

La Victoria is traversed by the little river Calanchas, running not into the Tuy, but into the Rio Aragua. It thence results, that this fine country, producing at once sugar and corn, belongs already to the basin of the lake of Valencia, to a system of interior rivers, which do not communicate with the sea. The quarter of the town West of the Rio Calanchas is called *la otra banda*; it is the most commercial part; merchandize is every where exhibited, and ranges of shops form the streets. Two commercial roads pass through La Victoria; that of Valencia, or of Porto Cabello, and the road of Villa de Cura, or of the plains, called *camino de los Llanos*. We here find more Whites in proportion than at Caraccas. We visited at sunset the little hill of Calvary, where the view is extremely fine and extensive. We discover on the West the smiling valleys of Aragua, a vast space covered with gardens, cultivated fields, clumps of wild trees, farms, and hamlets. Turning toward the South and South-East, we see, extending as far as the eye can reach, the lofty mountains of La Palma, Guayraima, Tiara, and Guiripa, which conceal the immense plains or steppes of Calabozo. This interior chain stretches to the West along the lake of

Valencia, toward the Villa de Cura, the Cuesta de Yusma, and the denticulated mountains of Guigue. It is very steep, and constantly covered with that light vapour, which in hot climates gives a vivid blue tint to distant objects, and, far from concealing their outlines, renders them more strongly marked. It is believed, that, among the mountains of the interior chain, that of Guayraima reaches an elevation of twelve hundred toises. I found, in the night of the eleventh of February, the latitude of La Victoria 10° 13′ 35″, the magnetic dip 40·8°, the intensity of the forces equal to 236 oscillations in 10′ of time*, and the variation of the needle 4·4° to the North-East.

We proceeded slowly on our way by the villages of San Matheo, Turmero, and Maracay, to the Hacienda de Cura, a fine plantation belonging to Count Tovar, where we did not arrive till the fourteenth of February, in the evening. The valley, which gradually widens, is bordered with hills of calcareous tufa, called here *tierra blanca.* The scientific men of the country have made several attempts to calcine this earth; mistaking it for the porcelain earth proceeding from the decomposition of strata of feldspar. We stayed some hours with a family equally enlightened and respectable, the Ustarizes, at *Concesion.* The house, which contains a collection of choice books, is placed on an eminence, and surrounded with plantations of coffee and sugar-canes. A grove of balsam-trees *(balsamo**) gives coolness and shade to this spot. We observed with a lively interest the great number of scattered houses in the valley, inhabited by freedmen. In the Spanish colonies the laws, the institutions, and the manners, are more favourable to the liberty of the Blacks, than in the other European settlements.

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* The intensities of the magnetic force at La Guayra, at La Venta Grande, between La Guayra and Caraccas, and at La Victoria, including from 234 to 236 oscillations, are the greatest I observed in Terra Firma. In this zone, where the dip is generally from 40° to 43°, the mean intensity of the forces corresponds to 226 or 228 oscillations. These augmentations depend no doubt on some local cause, in the neighbouring gneiss, mica-slate, and granite.

San Matheo, Turmero, and Maracay, are charming villages, where every thing announces persons in the most easy circumstances. We seemed to be transported to the most industrious parts of Catalonia. Near San Matheo we find the last fields of wheat, and the last mills with horizontal hydraulic wheels. A harvest of twenty for one was expected: and, as if the produce were but moderate, I was asked, whether corn produced more in Prussia and in Poland.

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* Amyris *elata.*

It is an error that generally prevails under the tropics, to consider grain as plants which degenerate in advancing toward the Equator; and to believe, that the harvests are more abundant in the northern climates. Since calculations have been made on the progress of agriculture in the different zones, and the temperatures under the influence of which corn will flourish, it has been found, that, beyond the latitude of 45°, the produce of wheat is no where so considerable, as on the northern coasts of Africa, and on the table-lands of New Grenada, Peru, and Mexico. Without comparing the mean temperature of the whole year, but only the mean temperature of the season which embraces the *cycle of vegetation* of corn, we find for three months of summer*, in the north of Europe, from

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* The *mean heat of the summers* of Scotland in the environs of Edinburgh, lat. 56°, is found again on the table-lands of New Grenada, so rich in wheat, at 1400 toises of elevation, and at 4° of latitude. On the other hand, we find the mean temperature of the valleys of Aragua, lat. 10° 13′, and of all the plains that are not very elevated in the torrid zone, in the *summer temperature* of Naples and Sicily, lat. 39° to 40°. These numbers indicate the situation of the *isotheric* lines (lines of the same summer heat), and not that of the *isothermal* lines (those of equal annual temperature). Considering the quantity of heat received on the same spot of the Globe during a whole year, the mean temperatures of the valleys of Aragua, and the table-lands of New Grenada, of 300 and 1400 toises of elevation, correspond to the mean

15° to 19°; in Barbary, and in Egypt, from 27° to 29°; within the tropics, between fourteen and six hundred toises of height, from 14° to 25·5° of the centigrade thermometer.

The fine harvests of Egypt and of the kingdom of Algiers, those of the valleys of Aragua and the interior of the island of Cuba, sufficiently prove, that the augmentation of heat is not prejudicial to the harvest of wheat and other alimentary grain, unless it is attended with an excess of drought or moisture. To this circumstance no doubt we must attribute the apparent anomalies, that are sometimes observed between the tropics, in the *inferior limit of corn**. We are astonished to see to the East of the Havannah, in the famous district of *Quatro Villas*, this limit descend almost to the level of the ocean; while to the West of the Havannah, on the slope of the mountains of Mexico and Xalapa, at six hundred and seventy-seven toises of height, the luxury of vegetation is such, that

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temperatures of the coasts at 23° and 45° of latitude. For the basis of these calculations, see my Essay on the Distribution of Heat in the *Mém. de la Soc. d'Arcueil*, vol. iii, p. 516, 579, 602: and above, vol. iii, p. 450.

* Since our return to Europe, Mr. Caldas has collected a great number of observations on this *limit*, in a memoir which ought to be found among the papers of our illustrious friend, Don Jose Celestino Mutis. See the Spanish translation of my Geography of Plants, in the *Semanario de N. Grenada*, vol. ii, p. 187.

wheat does not form ears. At the beginning of the conquest, the corn of Europe was cultivated with success in several regions, which are now thought too hot, or too damp, for this branch of agriculture. The Spaniards recently removed to America were less accustomed to live on maize; they still adhered to their European customs; they did not calculate whether corn would be less profitable than coffee or cotton; they tried seeds of every kind; they interrogated nature with more boldness, because their reasonings were less founded on false theories. The province of Carthagena, crossed by the chain of the mountains Maria and Guamoco, produced wheat till the sixteenth century*. In the province of Caraccas, this culture is very ancient among the mountainous lands of Tocuyo, Quibor, and Barquisimeto, which connect the littoral chain with the *Sierra Nevada* of Merida. It is still happily practised there, and the environs of the town of Tocuyo alone export annually more than eight thousand quintals of excellent flour. But, though the province of Caraccas, in it's vast extent, presents several spots very favourable to the cultivation of European corn, I believe, that in general this branch of agriculture will never become of great importance there. The most temperate valleys are not sufficiently wide; they are not real table-lands; and their mean elevation above the level of the sea is not considerable enough, for the inhabitants to avoid perceiving, that it is more their interest to establish plantations of coffee, than to cultivate corn. Flour now comes to Caraccas either from Spain, or from the United States. When, in circumstances more favourable to industry and public tranquillity, the road from Santa Fe de Bogota to the port of Pachaquiaro is laid open, the inhabitants of Venezuela will receive the flour of New Grenada by way of the Rio Meta and the Oroonoko.

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* *Don Ignacio de Pombo, Informe del real Consulado de Cartagena de Indias,* 1810, p. 75.

The village of Turmero is four leagues distant from San Matheo. The road leads through plantations of sugar, indigo, cotton, and coffee. The regularity, which we observed in the construction of the villages, reminded us, that they all owe their origin to monks and missions. The streets are straight and parallel; they cross each other at right angles; and the church is erected in the great square, situate in the centre. The church of Turmero is a sumptuous edifice, but overloaded with architectural ornaments. Since the missionaries have been replaced by vicars, the Whites have mixed their habitations with the Indians. The latter gradually disappear as a separate race; that is to say, they are represented in the general statement of the population by the Mestizoes and the Zamboes, whose numbers daily increase. I still found however four thousand tributary Indians in the valleys of Aragua. Those of Turmero and Guacara are the most numerous. They are little, but less squat than the Chaymas; their eyes announce more vivacity and intelligence, owing perhaps less to a diversity in the race, than to a superior state of civilization. They work like freemen by the day; they are active and laborious during the short time they allot to labour; but what they earn in two months is spent in one week, in buying strong liquors, at the small inns, of which unhappily the numbers daily increase.

We saw at Turmero the remains of the assembled militia of the country, and their appearance alone sufficiently indicated, that these valleys had enjoyed for ages undisturbed peace. The Capitania-general, in order to give a new impulse to the military service, had ordered a grand review; and the battalion of Turmero, in a mock fight, had fired on that of La Victoria. Our host, a lieutenant of the militia, was never weary of describing to us the danger of these manœuvres. "He had been surrounded with muskets, which might have burst at every instant; he had been kept four hours in the Sun, and his slaves were not permitted to hold an umbrella over his head." With what rapidity do nations, who appear the most pacific, acquire military habits! I then smiled at a timidity avowed with such simple frankness; and twelve years afterward those valleys of Aragua, those peaceful plains of La Victoria and Turmero, the defile of Cabrera, and the fertile banks of the lake of Valencia, have become the theatre of the most obstinate and bloody conflicts between the natives and the soldiers of the mother country.

To the South of Turmero, a mass of limestone mountains advances into the plain, separating two fine sugar-plantations, *Guayavita* and *Paja*. The latter belongs to the family of Count Tovar, who have property in every part of the province. Near Guayavita, brown iron ore has been discovered. To the North of Turmero, a granitic summit (the *Chuao*) rises in the Cordillera of the coast, from the top of which we discern at the same time the sea and the lake of Valencia. Crossing this rocky ridge, which runs toward the West farther than the eye can reach, paths somewhat difficult lead to the rich plantations of cacao on the coast, to Chóroni, Turiamo, and Ocumare, noted alike for the fertility of the soil, and the insalubrity of their climate. Turmero, Maracay, Cura, Guacara, every point of the valley of Aragua, has it's mountain-road, which terminates at one of the small ports on the coast.

Upon quitting the village of Turmero, we discover, at a league distant, an object, which appears at the horizon like a round hillock, or *tumulus*, covered with vegetation. It is neither a hill, nor a group of trees close to each other, but one single tree, the famous *zamang del Guayre*, known throughout the province for the enormous extent of it's branches, which form a hemispheric head five hundred and seventy-six feet in circumference. The zamang is a fine species of mimosa, the tortuous branches of which are divided by bifurcation. It's delicate and tender foliage displayed itself agreeably on the azure of the sky. We stopped a long time under this vegetable roof. The trunk of the zamang del Guayre*, which is found on the road from Turmero to Maracay, is only sixty feet high, and nine thick; but it's real beauty consists in the form of it's head. The branches extend like an immense umbrella, and bend toward the ground, from which they remain at a uniform distance of twelve or fifteen feet. The circumference of this head is so regular, that, having traced different diameters, I found them one hundred and ninety-two and one hundred and eighty-six feet. One side of the tree was entirely stripped of it's foliage, owing to the drought; and on the other side there remained at once leaves and flowers. Tillandsias, lorantheæ, cactus pitahayas, and other parasite plants, cover it's branches, and crack the bark. The inhabitants of these villages, but particularly the Indians, hold in veneration the zamang del Guayre, which the first conquerors found almost in the same state in which it now remains. Since it has been observed with attention, no change has appeared in it's thickness or height. This zamang must be at least as old as the Orotava dragon-tree. There is something solemn and majestic in the aspect of aged trees, and the violation of these monuments of nature is severely punished in countries, that are destitute of monuments of art. We heard with satisfaction, that the present proprietor of the zamang had brought an action against a farmer, who had had the temerity to cut off a branch. The cause was tried, and the tribunal condemned the farmer. We find near Turmero and the hacienda de Cura other zamangs, the trunks of which are larger than that of Guayre, but their hemispherical head is not of equal extent.

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* The *mimosa of la Guayre*, for *zamang* is the Indian name for the genera mimosa, desmanthus, and acacia. The place where the tree is found is called *el Guayre*. The mimosa *(inga)* saman of Jacquin *(Fragm. bot.*, p. 5, tab. ix), cultivated in the fine hot-houses of Schoenbrun, is not of the same species as the colossal tree of Turmero.

The culture and population of the plains augment as we advance toward Cura and Guacara, on the northern side of the lake. The valleys of Aragua contain more than 52,000 inhabitants, on a space of ground thirteen leagues long, and two wide. This is a relative population of two thousand souls on a square league, which equals almost that of the most populous parts of France. The village, or rather the small town of Maracay, was heretofore the centre of the indigo plantations, when this branch of colonial industry was in it's greatest prosperity. In 1795, seventy tradesmen had established shops in a population of six thousand inhabitants. The houses are all of masonry, and every court contains cocoa-trees, which rise above the habitations. The aspect of general wealth is still more striking at Maracay, than at Turmero. The anil, or indigo, of these provinces has always been considered in commerce as equal, and sometimes superior to that of Guatimala. This branch of culture has since 1772 followed that of cacao, and preceded the cultivation of cotton and coffee. The predilection of the colonists has been alternately fixed on each of these four productions; but the cacao and coffee are now the only important branches of commerce with Europe. In the most prosperous times the fabrication of indigo has almost equalled that of Mexico *; it rose in the province of Venezuela to 40,000 arrobas, or a million of pounds, the value of which exceeded 1,250,000 piastres †. I shall here give from official documents ‡, never before published, the progressive augmentation of this branch of agriculture at Aragua.

Exportation of Indigo by the way of La Guayra.

Annual mean from 1774 to 1778	20,300	pounds.
1784	126,233	
1785	213,172	
1786	271,005	
1787	432,570	
1788	505,956	
1789	718,393	
1792	680,229	
1794	898,353	
1796	737,966	

In this statement no attention has been paid to the contraband trade, which may be com-

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* The commerce of Guatimala amounts to 1,200,000 or 1,500,000 pounds of indigo.

† The pound of indigo at ten rials of plate.

‡ *Expediente relativo al Comercio y Crecido contrabando de la Provincia de Caracas, dirigido al Exc. Senor Don Pedro Varela, por el Conde de Casa Valencia,* 13 *Junio,* 1797.——*Informes de Don Esteban Fernandez de Leon, Intendente de Caracas, del* 26 *Sept.,* 1795. (MSS.)

puted for indigo at least at a fourth or fifth of the annual exportation. To form an idea of the immense riches arising from agriculture in the Spanish colonies, we must recollect, that the indigo of Caraccas, the value of which amounted in 1794 to more than six millions of franks, was the produce of four or five square leagues. In the years 1789—1795 near four or five thousand freemen came annually from the Llanos to the valleys of Aragua, to assist in the culture and fabrication of indigo. They worked during two months, by the day.

The indigo plant impoverishes the soil, where it is cultivated during a long series of years, more than any other. The lands of Maracay, Tapatapa, and Turmero, are looked upon as exhausted; and indeed the produce of indigo has been constantly decreasing. Maritime wars have caused a stagnation in the trade, and the price has fallen in consequence of the frequent importations of indigo from Asia. The East-India company now sells at London* more than 5,500,000 pounds weight of indigo, while in 1786 it did not draw from it's vast possessions more than 250,000 pounds. In proportion as the cultivation of indigo has decreased in the valleys of Aragua, it has increased in the province of Varinas, and in the burning plains of

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* For example, in 1810. See *Colquhoun*, *Append.* p. 23.

Cucuta, where, on the banks of the Rio Tachira, virgin land yields an abundant produce, and of the richest colour.

We arrived very late at Maracay, and the persons to whom we were recommended were absent. Scarcely was our embarrassment perceived by the inhabitants, when they contended with each other in offering to lodge us, to place our instruments, and take care of our mules. It has been said a thousand times, but the traveller always feels the desire of repeating it again, the Spanish colonies are the land of hospitality: they are so even in those places, where industry and commerce have diffused wealth and improvement among the planters. A family of Canarians received us with the most amiable cordiality: an excellent repast was prepared for us, and every thing was carefully avoided, that might act as any restraint on us. The master of the house * was travelling on commercial business, and his young wife had lately had the happiness of becoming a mother. She was transported with joy, when she heard, that on our return from the Rio Negro we should proceed by the banks of the Oroonoko to Angostura, where her husband was. We were to bear him the tidings of the birth of his first child. In those countries, as among the ancients,

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* Don Alexandro Gonzales.

travellers are looked upon by their hosts as the safest means of communication. There are indeed posts established, but they make such great circuits, that private persons seldom entrust them with letters for the Llanos, or savannahs of the interior. The child was brought to us at the moment of our departure; we had seen him asleep at night, but we must see him awake in the morning. We promised to describe his features exactly to his father, but the sight of our books and instruments somewhat chilled the mother's confidence. She said, "that in a long journey, amid so many cares of another kind, we might well forget the colour of her child's eyes." Soothing habits of hospitality! Ingenuous expressions of such confidence, as marks the first dawn of civilization!

On the road from Maracay to the Hacienda de Cura we enjoyed from time to time the view of the lake of Valencia. An arm of the granitic chain of the coast stretches toward the South into the plain. It is the promontory of Portachuelo, which would almost close the valley, if it were not separated by a narrow defile from the rock of La Cabrera. This place has acquired a mournful celebrity in the late revolutionary wars of Caraccas; each party having obstinately disputed it's possession, as opening the way to Valencia, and to the Llanos. La Cabrera now forms a peninsula; not sixty years ago it was a rocky island in the lake, the waters of which gradually diminish. We spent seven very agreeable days at the Hacienda de Cura, in a small habitation surrounded by thickets; for the house itself, situate in a fine sugar plantation, was infected with the *bubas* [*yaws?*], a disease of the skin very common among the slaves in these valleys.

We lived after the manner of the rich in this country; we bathed twice, slept three times, and made three meals in the twenty-four hours. The temperature of the water of the lake is rather warm, being from twenty-four to twenty-five degrees; but there is another cool and delicious bathing-place, under the shade of ceibas and large zamangs, at Toma, in a torrent gushing from the granitic mountains of the *Rincon del Diablo.* In entering this bath, we had not to fear the sting of insects, but the little brown hairs, that cover the pods of the dolichos pruriens, cowitch. When these small hairs, well characterised by the name of *pica-pica*, stick to the body, they excite a violent irritation on the skin; the dart is felt, but the cause is unperceived.

Near Cura we found all the people occupied in clearing the ground covered with mimosa, sterculia, and coccoloba excoriata, in order to extend the cultivation of cotton. This product, which partly supplies the place of that of indigo, has succeeded so well for some years, that the cotton-tree now grows wild on the borders of the lake of Valencia. We have found shrubs of eight or ten feet high, entwined with bignonia and other ligneous creepers. The exportation of cotton from Caraccas however is yet of small importance. It amounted at an average at La Guayra scarcely to three or four hundred thousand pounds in a year; but including all the ports of the *Capitania-general* it arose, on account of the flourishing culture of Cariaco, Nueva Barcelona, and Maracaybo, to more than 22,000 quintals*. This is nearly the half of the produce of the whole Archipelago of the

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* In 1794 the exportation from all the ports of the Capitania-general for Spain amounted to 804,075 pounds of cotton; for other Spanish colonies in America, particularly for the industrious province of Campeachy, where they manufacture a great quantity of cotton goods, 90,482; for foreign colonies, 117,281; total, 1,011,838 pounds. (*Informe del Sr Conde* de Casa Valencia, MS.) In the same year, La Guayra alone exported but 431,658 pounds, 126,436 pounds of which were from the province of Maracaybo. Exportation of this port (without including the contraband trade)

1789——170,427 pounds
1792——258,502
1796——537,178
1797——107,996

For the first six months of 1809, see the *Semanario de Santa Fe*, vol. ii, p. 324. The prices in 1794 were from thirty-four to fifty-six piastres the quintal.

West Indies*. The cotton of the valleys of Aragua is of a fine quality, being inferior only to that of Brazil; for it is preferred to that of Carthagena, St. Domingo, and the Caribbee islands. The cultivation of cotton extends on one side of the lake from Maracay to Valencia; and on the other, from Guayca to Guigue. The large plantations yield from sixty to seventy thousand pounds a year. When we reflect, that in the United States, consequently beyond the tropics, in a variable climate, often unfavourable to this produce, the exportation of indigenous cotton rose in eighteen years, from 1797 to 1815, from 1,200,000 pounds to 83,000,000, it is difficult to form an idea of the immense extent, which this branch of commerce† will attain, when national industry shall cease to be shackled in the united provinces of Venezuela, in New Grenada, in Mexico, and on the banks of the river Plate. In the present state of things, the coasts of Dutch Guyana, the gulf of Cariaco, the valleys of Aragua, and the provinces of Maracaybo and Carthagena, produce, next to Brazil, the greatest quantity of cotton in South America.

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* Mr. Medford, in his researches on the manufactories of England, reckons, that, of 61,380,000 pounds of cotton, which these manufactories consumed in 1805, there were thirty-one millions from the United States; ten millions from Brazil; and ten millions from the West Indies. This last quantity was not the produce of a single year, or of the islands alone. The great and little islands together produced in 1812 only 5,200,000 pounds of cotton, the greater part of which grew in Barbadoes, the Bahama Islands, Dominica, and Grenada. The produce of the soil of the West Indies must not be confounded with their exportation, which is augmented by the carrying trade. Colquhoun, p. 378; Page, tom i, p. 3.

† The cotton manufactures of Great Britain alone furnish, in all kinds of cotton goods (printed calicoes, stockings, &c.)

During our stay at Cura, we made numerous excursions to the rocky islands, that rise in the midst of the lake of Valencia, to the warm springs of Mariara, and to the lofty granitic mountain, called *el Cucurucho de Coco;* a dangerous and narrow path leads to the port of Turiamo and the celebrated cacao-plantations of the coast. In all these excursions we were agreeably surprised, not only at the progress of agriculture, but the increase of a free, laborious population, accustomed to toil, and too poor to rely on the assistance of slaves. White and mulatto farmers had every where small separate establishments. Our host, whose father had a revenue of 40,000 piastres, possessed more lands than he could clear; he distributed them in the valleys of Aragua among poor families, who

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to the value of twenty-nine millions sterling; and the value of the material, in it's unwrought state, amounts to six millions.

chose to apply themselves to the cultivation of cotton. He endeavoured to surround his ample plantations with freemen, who, working as they chose, either in their own land, or in the neighbouring plantations, supplied him with day-labourers at the time of harvest. Nobly occupied on the means best adapted gradually to extinguish the slavery of the Blacks in these provinces, Count Tovar flattered himself with the double hope of rendering slaves less necessary to the landholders, and furnishing the freedmen with opportunities of becoming farmers. On departing for Europe he had parcelled out and let a part of the lands of Cura, which extend toward the West at the foot of the rock of Las Viruelas. Four years after, at his return to America, he found on this spot, finely cultivated in cotton, a little hamlet of thirty or forty houses, which is called *Punta Zamuro*, and which we after visited with him. The inhabitants of this hamlet are almost all Mulattoes, Zamboes, or free Blacks. This example of letting out land has been happily followed by several other great proprietors. The rent is ten piastres for a *vanega* of ground, and is paid in money, or in cotton. As the small farmers are often in want, they sell their cotton at a very moderate price. They sell it even before the harvest; and these advances, made by rich neighbours, place the debtor in a situation of dependance, which frequently obliges him to offer his services as a labourer. The price of hands is cheaper here than in France. A freeman, working as a day-labourer *(peon)*, is paid in the valleys of Aragua, and in the Llanos, four or five piastres a month, not including food, which is very cheap on account of the abundance of meat and vegetables. I love to dwell on these details of colonial industry, because they prove to the inhabitants of Europe, what to the enlightened inhabitants of the colonies has long ceased to be doubtful, that the continent of Spanish America can produce sugar and indigo by free hands; and that the unhappy slaves are capable of becoming peasants, farmers, and landholders.

CHAPTER XVI.

Lake of Tacarigua.—Hot Springs of Mariara.—Town of Nueva Valencia de el Rey.—Descent toward the coasts of Porto Cabello.

The valleys of Aragua, of which we have displayed the rich cultivation and the admirable fecundity, form a narrow basin between granitic and calcareous mountains of unequal height. On the North, they are separated by the Sierra Mariara from the seacoast; and toward the South, the chain of Guacimo and Yusma serves them as a rampart against the heated air of the steppes. Groups of hills, high enough to determine the course of the waters, close this basin on the East and West, like transverse dikes. We find these hills between the Tuy and La Victoria *, as well as on the road from

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* The lofty mountains of Los Teques, which give birth to the Tuy, may be looked upon as the eastern boundary of the valleys of Aragua. The level of the ground continues in fact to rise from La Victoria (269 t.) to the Hacienda de

Valencia to Nirgua, and at the mountains of Torito. From this extraordinary configuration of the land, the little rivers of the valleys of Aragua form a peculiar system, and direct their course toward a basin closed on all sides. These rivers do not bear their waters to the ocean; they are collected in an interior lake, and, subject to the powerful influence of evaporation, they lose themselves, if we may use the expression, in the atmosphere. On the existence of these rivers and lakes the fertility of the soil, and the produce of cultivation in these valleys, depend. The aspect of the spot, and the experience of half a century have proved, that the level of the waters is not invariable; the waste by evaporation, and the increase from the waters running into the lake, do not uninterruptedly balance each other. The lake, being elevated one thousand feet above the neighbouring steppes of Calabozo, and one thousand three hundred and thirty-two feet above the level of the ocean, it has been suspected, that

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Tuy (295 t.): but the river Tuy, turning South toward the Sierras of Guairaima and Tiara, has found an issue on the East; and it is more natural to consider as the limits of the basin of Aragua a line drawn through the sources of the streams flowing into the lake of Valencia. The charts and sections I have traced of the road from Caraccas to Nueva Valencia, and from Porto Cabello to Villa de Cura, exhibit the whole of these geological relations.

there are subterraneous communications and filtrations. The appearance of new islands, and the gradual retreat of the waters, have led to the belief, that the lake may perhaps become entirely dry. An assemblage of physical circumstances so remarkable was well fitted to fix my attention on those valleys, where the wild beauty of nature is embellished by agricultural industry, and the arts of rising civilization.

The lake of Valencia, called Tacarigua* by the Indians, exceeds in magnitude the lake of Neufchatel in Switzerland; but it's general form has more resemblance to the lake of Geneva, which is nearly at the same height above the level of the sea. The slope of the ground in the valleys of Aragua tending toward the South and the West, that part of the basin, which has remained covered with water, is the nearest to the southern chain of the mountains of Guigue, of Yusma, and of Guacimo, which stretch toward the high savannahs of Ocumare. The opposite banks of the lake of Valencia display a singular contrast; those on the South are desert, and almost uninhabited, and a screen of high mountains gives them a gloomy and monotonous aspect. The northern shore, on the contrary, is cheerful, pastoral, and decked with the rich cultivation of the sugar-cane, coffee-tree, and cotton. Paths, bordered with cestrums, azedaracs, and other shrubs, always in flower, cross the plain, and join the scattered farms. Every house is surrounded by clumps of trees. The ceiba with it's large yellow * flowers gives a peculiar character to the landscape, mingling it's branches with those of the purple erithryna. This mixture of vivid vegetable colours contrasts with the uniform tint of an unclouded sky. In the season of drought, where the burning soil is covered with an undulating vapour, artificial irrigations preserve the verdure and fertility. Here and there the granitic rock pierces through the cultivated ground. Enormous stony masses rise abruptly in the midst of the valley. Bare and forked, they nourish a few succulent plants, which prepare mould for future ages. Often at the summit of these lonely hills a fig-tree or a clusia with fleshy leaves has fixed it's roots in the rock, and towers over the landscape. With their dead and withered branches they look like signals erected on a steep cliff. The form of these mounts betrays the secret of their ancient origin; for, when the whole of this valley was filled with water, and the waves beat at the foot of the peaks of Mariara, the Devil's Wall †, and the

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* Fray Pedro Simon calls the lake, no doubt by mistake, Acarigua and Tarigua. (Notic. Hist., p. 533 and 668.)

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* *Carnes tollendas;* bombax *hibiscifolius.*

† *El Rincon del Diablo.*

chain of the coast, these rocky hills were shoals or islets.

These features of a rich landscape, these contrasts between the two banks of the lake of Valencia, often reminded me of the situations of the Pays de Vaud, " where the earth, every where cultivated, and every where fertile, offers the husbandman, the shepherd, and the vine-dresser, the secure fruit of their labours," while the opposite side of Chablais presents only a mountainous and half-desert country. In these distant climes, surrounded with the productions of an exotic nature, I loved to recall to mind the enchanting descriptions, with which the aspect of the Leman lake and the rocks of La Meillerie inspired a great writer. Now, while in the centre of civilized Europe, I endeavour in my turn to paint the scenes of the New World, I do not imagine I present the reader with clearer images, or more precise ideas, by comparing our landscapes with those of the equinoctial regions. It cannot be too often repeated, that Nature, under every zone, whether wild or cultivated, smiling or majestic, displays an individual character. The impressions, which she excites, are infinitely varied, like the emotions produced by works of genius, according to the age in which they were conceived, and the diversity of languages from which they derive a part of their charms. We can justly compare only what belongs to dimensions and external forms. We may institute a parallel between the colossal summit of Mount Blanc, and the mountains of Himalaya; the cascades of the Pyrenees and those of the Cordilleras: but these comparisons, useful with respect to science, fail to make known what characterises Nature in the temperate and torrid zones. On the banks of a lake, in a vast forest, at the foot of summits covered with eternal snows, it is not the simple magnitude of the objects, that penetrates us with secret admiration. What speaks to the soul, what causes such profound and various emotions, escapes our measurements, as it does the forms of language. Those who feel powerfully the charms of Nature fear to weaken their enjoyments by comparing scenes of a different character.

But it is not alone the picturesque beauties of the lake of Valencia, that have given celebrity to it's banks. This basin displays several other phenomena, the solution of which is interesting alike to physical science and to the well-being of the inhabitants. What are the causes of the diminution of the waters of the lake? Is this diminution more rapid now than in former ages? Can we presume, that an equilibrium between the waters flowing in and the loss will be shortly reëstablished? or may we apprehend, that the lake will entirely disappear?

According to astronomical observations * made at La Victoria, Hacienda de Cura, Nueva Valencia, and Guigue, the length of the lake, in it's present state, from Cagua to Guayos, is ten leagues, or twenty-eight thousand eight hundred toises. It's breadth is very unequal. If we judge from the latitudes of the mouth of the Rio Cura and the village of Guigue, it no where surpasses 2·3 leagues, or six thousand five hundred toises; most commonly it is but four or five miles. The dimensions resulting from my observations are much less, than those hitherto adopted by the natives †. It might be thought, that, to form a precise idea of the progressive diminution of the waters, it would suffice to compare the present dimensions of the lake with those attributed to it by ancient chroniclers; by Oviedo, for instance, in his History of the Province of Venezuela, published about the year 1723. This writer, in his emphatic style, gives "this interior sea, this *monstruoso cuerpo de la laguna de Valencia*," fourteen leagues in length and six in breadth. He relates, that at a small distance from the shore, the lead finds no bottom; and that large floating islands cover the surface of the waters, which are constantly agitated by the winds*. No importance can be attached to estimations, which, without being founded on any measurement, are expressed in leagues, *leguas*, reckoned in the colonies at three thousand, five thousand, and six thousand six hundred and fifty *varas*†. What is worthy of our attention in the works of a man, who must so often have passed over the valleys of Aragua, is the assertion, that the town of *Nueva Valencia de el Rey* was built in 1555, at the distance of half a league from the lake‡; and that the proportion between the length of the lake, and it's breadth, is as seven to three. At present the town of Valencia is separated from the lake by level ground of more than two thousand seven hundred toises, which Oviedo would no doubt have estimated as a space of a league and a half; and the length of the basin of the lake is to it's breadth as 10 to 2·3, or as 7 to 1·6. The appearance of the soil between Valencia and Guigue, the little hills that rise abruptly in the plain, East of the Cano de Cambury, and some of which (el Islote and la Isla de la Negra, or Caratapona) have even preserved the name of islands, sufficiently prove, that the waters have retired considerably since the time of Oviedo. With respect to the change in the general form of the lake, it appears to me improbable, that in the seventeenth century it's breadth was nearly the half of it's length. The situation of the granitic mountains of Mariara and of Guigue, the slope of the ground, which rises more rapidly toward the North and South than toward the East and West, are alike repugnant to this supposition.

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* The itinerary distances from La Victoria to Cagua, as well as those from Guacara to Mocundo and to Los Guayos, were taken into consideration. Angles were taken at the island of Cura, at Cabo Blanco, and at Mocundo.

† *Depons, Voyage à La Terre Ferme*, vol. i, p. 138.

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* Oviedo, p. 125.

† Seamen being the first, and for a long time the only persons, who introduced into the Spanish colonies any precise ideas on the astronomical position and distances of places, it was the *legua nautica* of 6650 *varas*, or of 2854 toises, 20 in a degree, that was originally used in Mexico and South America; but this *legua nautica* has been gradually reduced to one half or one third, on account of the slowness of travelling across steep mountains, or dry and burning plains. The common people measure only time directly; and then, by arbitrary hypotheses, infer from the time the space of ground travelled over. In the course of my geographical researches, I have had frequent opportunities of examining the real value of *leagues*, by comparing the itinerary distances between points lying under the same meridian with the difference of latitudes.

‡ Oviedo, p. 140.

In treating the long-discussed question of the diminution of the waters, I couceive we must distinguish the different periods, at which the sinking of their level has taken place. Wherever we examine the valleys of rivers, or the basins of lakes, we see the ancient shore at great distances. No doubt seems now to be entertained, that our rivers and lakes have undergone immense diminutions; but many geological facts remind us also, that these great changes in the distribution of the waters have preceded all historical times; and that for many thousand years most lakes have attained a permanent equilibrium between the produce of the water flowing in, and that of evaporation and filtration. Whenever we find this equilibrium broken, it will be more prudent to examine, whether the rupture be not owing to causes merely local, and of a very recent date, than to admit an uninterrupted diminution of the water. This reasoning is conformable to the more circumspect method of modern science. At a time when the physical history of the world, traced by the genius of some eloquent writers, borrowed all it's charms from the fictions of imagination, a new proof would have been found, in the phenomenon of which we are treating, of the contrast that these writers were fond of establishing between the two continents. To demonstrate, that America rose later than Asia and Europe from the bosom of the waters, they would have cited the lake of Tacarigua as one of those interior basins, which have not had time to become dry by the effects of a slow and gradual evaporation. I have no doubt, that, in very remote times, the whole valley, from the foot of the mountains of

Cocuyza to those of Torito and Nirgua, and from La Sierra de Mariara to the chain of Guigue, of Guacimo, and La Palma, was filled with water. Every where the form of the promontories, and their steep declivities, seem to indicate the shore of an alpine lake, similar to those of Styria and Tyrol. The same little helicites, the same valvæ, which now live in the lake of Valencia, are found in layers of three or four feet in the island, as far as Turmero and *La Concesion* near La Victoria. These facts undoubtedly prove a retreat of the waters; but nothing indicates, that this retreat has continued from that remote period to our days. The valleys of Aragua are one of the parts of Venezuela the most anciently peopled; and yet there is no mention in Oviedo, or any other old chronicler, of a sensible diminution of the lake. Ought we simply to suppose, that this phenomenon escaped their observation, at a time when the Indian population far exceeded the white, and when the banks of the lake were less inhabited? Within half a century, and particularly within these thirty years, the natural desiccation of this great basin has excited general attention. We find vast spaces of land that were formerly inundated, now dry, and already cultivated with plantains, sugar-canes, or cotton. Wherever a hut is erected on the bank of the lake, we see the shore receding from year to year. We discover islands, which, in consequence of the retreat of the waters, scarcely begin to be joined to the continent, as the rocky island of Culebra, on the side of Guigue; other islands already form promontories, as the Morro, between Guigue and Nueva Valencia, and La Cabrera, South-East of Mariara; others now rise in the islands, like scattered hills. Among these last, so easily recognised at a distance, some are only a quarter of a mile, others a league from the present shore. I shall cite as the most remarkable three granitic islands, thirty or forty toises high, on the road from Hacienda de Cura to Aguas Calientes; and at the western extremity of the lake, the Serrito de Don Pedro, Islote, and Caratapona. On visiting two islands * entirely surrounded by water, we found in the midst of brush-wood, on small flats of four, six, and even eight toises height above the surface of the lake, fine sand mixed with helicites, anciently deposited by the waters. In each of these islands may be perceived the most certain traces of the gradual sinking of the waters. But still farther, and this accident is regarded by the inhabitants as a marvellous phenomenon,

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* Isla de Cura, and Cabo Blanco. The promontory of Cabrera has been connected with the shore ever since the year 1750 or 1760, by a vale, which bears the name of Portachuelo.

in 1796, three new islands appeared to the East of the island Caiguira, in the same direction as the islands Burro, Otama, and Zorro. These new islands, called by the people *los nuevos Penones*, or *las Aparecidas*, form a kind of banks, with surfaces quite flat. They rose already, in 1800, more than a foot above the *mean level of the waters*.

We observed at the beginning of this chapter, that the lake of Valencia, like the lakes of the valley of Mexico [*] forms the centre of a little system of rivers, none of which have any communication with the ocean. These rivers for the greater part deserve only the name of torrents, or brooks [†]; they are twelve or fourteen in number. The inhabitants, little acquainted with the effects of evaporation, have long imagined, that the lake has a subterranean outlet, by which a quantity of water runs out equal to that which flows in by the rivers. Some suppose, that this outlet communicates with grottoes, which they place at great depths; others admit, that the water flows through an oblique channel into the basin of the ocean. These bold hypotheses on the communication between two neighbouring basins have presented themselves under every zone to the imagination of the vulgar, as well as to that of natural philosophers; for the latter, without confessing it, sometimes repeat popular opinions in scientific language. We hear of subterranean gulfs and outlets in the New World, as on the shores of the Caspian sea, though the lake of Tacarigua is two hundred and twenty-two toises higher, and the Caspian sea fifty-four toises lower, than the ocean; and though it is well known, that fluids find the same level, when they communicate by a lateral channel.

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[*] Before the opening dug by the Spaniards near Huehuetoque, and known by the name of *Desague Real*.

[†] The following are their names: Rios de Aragua, Turmero, Maracay, Tapatapa, Aguas Calientes, Mariara, Cura, Guacara, Guataparo, Valencia, Cano grande de Cambury, &c.

The changes, which the destruction of forests, the clearing of plains, and the cultivation of indigo, have produced within half a century in the quantity of water flowing in on the one hand; and on the other the evaporation of the soil, and the dryness of the atmosphere, present causes sufficiently powerful to explain the successive diminution of the lake of Valencia. I am not of the opinion of a traveller, who has visited these countries since me *, that "to set

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* Mr. *Depons* (*Voyage à la Terre Ferme, vol.* i, *p.* 139) adds: "The small extent of the surface of the lake" (it amounts however to 106,500,000 square toises) "renders impossible the supposition, that evaporation alone, however considerable under the tropics, could remove as much water, as the rivers furnish." In the sequel, the author himself seems to abandon "this occult cause, the hypothesis of an aperture."

the mind at rest, and for the honour of science," a subterranean issue must be admitted. By felling the trees, that cover the tops and the sides of mountains, men in every climate prepare at once two calamities for future generations; the want of fuel, and a scarcity of water. Trees, by the nature of their perspiration, and the radiation from their leaves in a sky without clouds, surround themselves with an atmosphere constantly cool and misty. They affect the copiousness of springs, not, as was long believed, by a peculiar attraction for the vapors diffused through the air, but because, by sheltering the soil from the direct action of the Sun, they diminish the evaporation of the water produced by rain. When forests are destroyed, as they are every where in America by the European planters, with an imprudent precipitation, the springs are entirely dried up, or become less abundant. The beds of the rivers, remaining dry during a part of the year, are converted into torrents, whenever great rains fall on the heights. The sward and moss disappearing with the brush-wood from the sides of the mountains, the waters falling in rain are no longer impeded in their course: and instead of slowly augmenting the level of the rivers by progressive filtrations, they furrow during heavy showers the sides of the hills, bear down the loosened soil, and form those sudden inundations, that devastate the country. Hence it results, that the destruction of forests, the want of permanent springs, and the existence of torrents, are three phenomena closely connected together. Countries that are situate in opposite hemispheres, Lombardy bordered by the chain of the Alps, and Lower Peru inclosed between the Pacific Ocean and the Cordillera of the Andes, exhibit striking proofs of the justness of this assertion *.

Till the middle of the last century, the mountains that surround the valleys of Aragua were covered with forests. Great trees of the families of mimosa, ceiba, and the fig-tree, shaded and spread coolness along the banks of the lake. The plain, then thinly inhabited, was filled with brush-wood, interspersed with trunks of scattered trees and parasite plants, envelopped with a thick sward, less capable of emitting radiant caloric than the soil that is cultivated, and therefore not sheltered from the rays of the Sun. With the destruction of trees, and the increase of the cultivation of sugar, indigo, and cotton, the springs, and all the natural supplies of the lake of Valencia, have diminished from year to year. It is difficult to form a just idea of the enormous quantity of evaporation, that takes place under the torrid zone, in a valley

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* See my political Essai on New Spain, vol. i, p. 208, and the *Recherches de M. de Prony sur les Crues du Pô.*

surrounded with steep declivities, where a regular breeze and descending currents of air are felt toward evening, and the bottom of which is flat, and looks as if it were levelled by the waters. We have elsewhere remarked, that the heat, which prevails throughout the year at Cura, Guacara, Nueva Valencia, and on the borders of the lake, is the same as that which is felt at midsummer in Naples and Sicily. The mean annual temperature of the valleys of Aragua is nearly 25·5°*; my hygrometrical observations of the month of February, taking the mean of day and night, gave 71·4° of the hair-hygrometer †. As the words great drought and great humidity have no determinate signification, and an air, that would be called very dry in the lower regions of the tropics, would be regarded as a humid air in Europe, we can judge of these relations between climates only by comparing spots placed under the same zone. Now at Cumana, where it sometimes does not rain during a whole year, and where I had the means of collecting a great number of hygrometric observations made at different hours of the day and night, the mean humidity of the air is 86°; corresponding to the mean temperature of 27·7° cent. Taking into account the influence of the rainy months, that is to say, estimating the difference observed in other parts of South America between the mean humidity of the dry months and that of the whole year; an annual mean humidity is obtained, for the valleys of Aragua, at farthest of 74°, the temperature being 25·5°. In this air, so hot, and at the same time so little humid, the quantity of water evaporated is enormous. The theory of Dalton estimates, under the conditions just stated, for the thickness of the sheet of water evaporated in an hour's time 0·36 *mill.* or 3·8 lines in twenty-four hours *. Assuming for the temperate zone, for instance at Paris, the mean temperature to be 10·6°, and the mean humidity 82°, we find, according to the same formulæ, 0·10 *mill.* an hour, and 1 line for twenty-four hours. If we prefer substituting for the uncertainty of these theoretical deductions the direct results of observation, we may recollect, that at Paris, and at Montmorenci, the mean annual evaporation was found by Sedileau and Cotte, to be from 32 in. 1 line to 38 in. 4 lines. Two able engineers in the South of France, Messrs. Clausade and Pin, found, that in subtracting the effects of filtrations, the waters of the canal of Languedoc, and the basin of Saint Ferréol, lose every year from 0·758 met. to 0·812 met. or from 336 to 360 lines. Mr. de Prony found nearly similar results in the Pontine marshes. The whole of these experiments, made in the latitudes of 41° and 49°, and at 10·5° and 16° of mean temperature, indicate a mean evaporation of one line, or one and three tenths, a day. Under the torrid zone, in the West India islands for instance, the effect of evaporation is four times as much, according to Le Gaux, and double according to Cassan. At Cumana in a place where the atmosphere is far more loaded with humidity than in the valley of Aragua, I have often seen evaporate, during twelve hours, in the sun, 8·8 *mill.*, in the shade 3·4 *mill.*; and I believe, that the annual produce of evaporation in the rivers near Cumana is not below one hundred and thirty inches. Experiments of this kind are extremely delicate, but what I have related will suffice to demonstrate how great must be the quantity of vapour, that rises from the lake of Valencia, and from the surrounding country, the waters of which flow into the lake. I shall have occasion elsewhere to resume this subject; for, in a work which displays the great laws of nature under different zones, we must endeavour to solve the problem of the *mean tension of the vapours* contained in the atmosphere in different latitudes, and at different heights above the surface of the ocean.

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* 20·4° Reaumur. According to the observations of the month of February, 19·5° R.; and, at Cumana, this month is 0·7° R. below the mean temperature of the year.

† These 71·4° of apparent humidity correspond to a mean temperature of 24·3°.

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* Compare, at the end of the first book, vol. ii, p. 90.

A great number of local circumstances cause the produce of evaporation to vary; it changes as more or less shade covers the basin of the waters, with their state of motion or of repose, with their depth, and the nature and colour of their bottom: but in general evaporation depends only on three circumstances, the temperature, the tension of the vapours contained in the atmosphere, and the resistance which the air, more or less dense, more or less agitated, opposes to the diffusion of vapour. The quantity of water, that evaporates in a given spot, every thing else being equal, is proportional to the difference between the quantity of vapour, which the ambient air can contain when saturated, and the quantity, which it actually contains. Hence it follows (as Mr. Daubuisson has already observed, in subjecting my hygrometic observations to calculation), that the evaporation is not so great under the torrid zone, as might be expected from the enormous augmentation of temperature; because, in those ardent climates, the air is habitually very humid.

Since the increase of agricultural industry in the valleys of Aragua, the little rivers, that run into the lake of Valencia, can no longer be regarded as real supplies during the six months succeeding December. They remain dried up in the lower part of their course, because the planters of indigo, coffee, and sugar-canes, have made frequent drainings *(azequias)*, in order to water the ground by trenches. We may observe also, that a pretty considerable river, the Rio Pao, which rises at the entrance of the Llanos, at the foot of the range of hills called *La Galera*, heretofore mingled it's waters with those of the lake, by uniting itself with the *Cano de Cambury*, on the road from the town of Nueva Valencia to Guigue. The course of this river was then from South to North. At the end of the seventeenth century, the proprietor of a neighbouring plantation thought proper to dig at the back of the hill a new bed for the Rio Pao. He turned the river; and, after having employed part of the water for the irrigation of his fields, he caused the rest to flow at a venture toward the South, following the declivity of the Llanos. In this new southern direction the Rio Pao, mingled with three other rivers, the Tinaco, the Guanarito, and the Chilua, falls into the Portuguesa, which is a branch of the Apure. It is a remarkable phenomenon, to observe, that by a particular disposition of the ground, and the lowering of the *ridge of division* toward the South-West, the Rio Pao separates itself from the little *system of interior rivers*, to which it originally belonged, and for a century past has communicated, through the channel of the Apure and the Oroonoko, with the ocean. What has been here effected on a small scale by the hand of man, Nature often performs, either by progressively elevating the level of the soil, or by those falls of the ground, which violent earthquakes occasion. It is probable, that, in the lapse of ages, several rivers of Soudan, and of New Holland, which are now lost in the sands, or in inland basins, will open themselves a way toward the shores of the ocean. We cannot at least doubt, that in both continents there are systems of interior rivers, which may be considered as *not entirely developed* *; and which communicate with each other, either in the time of great risings, or by permanent bifurcations.

The Rio Pao has scooped itself out a bed so deep and broad, that in the season of rains, when the *Cano grande de Cambury* inundates all the land to the North-West of Guigue, the waters of this *Cano*, and those of the lake of Valencia, flow back into the Rio Pao itself; so that this river, instead of adding water to the lake, tends rather to carry it away. We see something similar in North America, where geographers have chosen to represent on their maps an imaginary chain of mountains, between the great lakes of Canada and the country of the Miamis. At the time of floods, the waters flowing into the lakes communicate with those which run into the Missisippi; and it is practicable to proceed by boats from the sources of the river St. Mary to the Wabash, as well as from the Chicago to the Illinois *. These analogous facts appear to me well worthy of the attention of hydrographers.

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* *Carl Ritter, Erdkunde*, vol. i, p. 315.

The land that surrounds the lake of Valencia being entirely flat and even, what I daily observed in the lakes of Mexico takes place here; a diminution of a few inches in the level of the water exposes a vast extent of ground covered with fertile mud and organic remains. In proportion as the lake retires, the planters advance toward the new shore. These natural desiccations, so important to the colonial agriculture, have been eminently considerable during the last ten years, in which all America has suffered from great droughts. Instead of marking the sinuosities of the present banks of the lake, I have advised the rich landholders in these countries, to place columns of granite in the basin itself, in order to observe from year to year the mean height of the waters. The Marquis del Toro has undertaken to put this design into execution, employing the fine granite of the

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* Drake, Picture of Cincinnati, 1815, p. 222.

Sierra de Mariara, and establishing *limnometers*, on a bottom of gneiss rock, so common in the lake of Valencia.

It is impossible to anticipate the limits, more or less narrow, to which this basin of water will one day be confined, when an equilibrium, between the streams flowing in and the produce of evaporation and filtration, shall be completely established. The idea very generally spread, that the lake will soon entirely disappear, seems to me chimerical. If in consequence of great earthquakes, or other causes equally mysterious, ten very humid years should succeed to long droughts; if the mountains should clothe themselves anew with forests, and great trees overshadow the shore and the plains of Aragua; we should more probably see the volume of the waters augment, and menace that beautiful cultivation, which now trenches on the basin of the lake.

While some of the cultivators of the valleys of Aragua fear the total disappearance of the lake, and others it's return toward the banks it has deserted, we hear the question gravely discussed at Caraccas, whether it would not be advisable, in order to give greater extent to agriculture, to conduct the waters of the lake into the Llanos, by digging a canal toward the Rio Pao. The possibility* of this enterprise cannot be denied, particularly by having recourse to tunnels, or subterranean canals. The progressive retreat of the waters has given birth to the beautiful and luxuriant plains of Maracay, Cura, Mocundo, Guigue, and Santa Cruz del Escoval, planted with tobacco, sugar-canes, coffee, indigo, and cacao; but how can it be doubted for a moment, that the lake alone spreads fertility over this country? Deprived of an enormous mass of vapours, which the surface of the waters sends forth daily into the atmosphere, the valleys of Aragua would become

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* The *dividing ridge*, namely, that which divides the waters

between the valleys of Aragua and the Llanos, lowers so much toward the West of Guigue, as we have already observed, that there are ravines, which conduct the waters of the Cano de Cambury, the Rio Valencia, and the Guataparo, in the time of floods, to the Rio Pao; but it would be easier to open a navigable canal from the lake of Valencia to the Oroonoko, by the Pao, the Portuguesa, and the Apure, than to dig a draining canal level with the bottom of the lake. This bottom, according to the sounding, and my barometric measurements, is 40 toises less than 222, or 182 above the surface of the ocean. On the road from Guigue to the Llanos, by the table-land of La Villa de Cura, I found, to the South of the *dividing ridge*, and on it's southern declivity, no point of level corresponding to the 182 toises, except near San-Juan. The absolute height of this village is 194 toises. But, I repeat, that farther toward the West, in the country between the Cano de Cambury and the sources of the Rio Pao, which I was not able to visit, the point of level of the bottom of the lake is much more toward the North.

as dry and barren as the surrounding mountains.

The mean depth of the lake is from twelve to fifteen fathoms; the deepest parts are not, as is generally admitted, eighty, but thirty-five or forty deep. Such is the result of soundings made with the greatest care by Don Antonio Manzano. When we reflect on the vast depths of all the lakes of Switzerland, which, notwithstanding their position in high valleys, almost reach the level of the Mediterranean, it appears surprising, that greater cavities are not found at the bottom of the lake of Valencia, which is also an Alpine lake. The deepest places are between the rocky island of Burro and the point of Cana Fistula, as opposite the high mountains of Mariara. But in general the southern part of the lake is deeper than the northern: nor must we forget, that, if all the shores be now low, the southern part of the basin is the nearest to a chain of mountains with abrupt declivities; and we know, that even the sea is generally deepest where the coast is elevated, rocky, or perpendicular.

The temperature of the lake, at the surface, during my abode in the valleys of Aragua, in the month of February, was constantly from 23° to 23·7°, consequently a little below * the mean

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* From 0·6° to 1·3°.

temperature of the air; either from the effect of evaporation*, which carries off caloric from the air and the water; or because a great mass of water does not follow with an equal rapidity the changes of temperature of the atmosphere, and the lake receives streams, that rise from several cold springs in the neighbouring mountains. I have to regret, that, notwithstanding it's small depth, I could not determine the temperature of the water at thirty or forty fathoms. I was not provided with the thermometrical sounding apparatus, which I had used in the Alpine lakes of Saltzburg†, and in the Caribbean sea. The experiments of Saussure prove, that, on both sides of the Alps, the lakes that are from one hundred and ninety to two hundred and seventy-four toises of absolute elevation*, have, in the middle of winter, at nine hundred, at six hundred, and sometimes even at one hundred and fifty feet of depth, a uniform temperature from 4·3 to 6 cent. degrees; but these experiments have not yet been repeated in lakes situate under the torrid zone. The strata of cold water in Switzerland are of an enormous thickness. They have been found so near the surface in the lakes of Geneva and Bienne, that the decrement of heat in the water was one centesimal degree for ten or fifteen feet: that is to say, eight times more rapid than in the ocean, and forty-eight times more rapid than in the atmosphere†. Under the temperate zone, where the heat of the atmosphere sinks to the freezing point, and far lower, the bottom of a lake, even were it not surrounded by glaciers and mountains covered with eternal snow, must contain particles of water, which, having during winter acquired at the surface the maximum of their density, between 3·4° and 4·4°, have consequently fallen to the greatest depth. Other particles, the temperature of which is + 0·5°, far from placing themselves below the stratum at 4°, can only find their hydrostatic equilibrium above that stratum. They will descend lower only when their temperature is augmented 3° or 4°, by the contact of strata less cold. If water in cooling continued to condense itself uniformly to the freezing point, there would be found in very deep lakes, and basins of water that have no communication with each other, *whatever were the latitude of the place,* a stratum of water, the temperature of which would be nearly equal to the maximum of refrigeration above the freezing point, which the lower regions of the ambient atmosphere annually attain. From this consideration it is probable, that, in the plains of the torrid zone, or in the valleys but little elevated, the mean heat of which is from 25·5° to 27°, the temperature of the bottom of the lakes can never be below 21° or 22°. If in the same zone the ocean contain, at depths of seven or eight hundred fathoms, waters the temperature of which is at 7°, that is to say twelve or thirteen degrees colder than the maximum of the heat * of the equinoctial atmosphere over the sea, I think it must be considered as a direct proof of a submarine current, carrying the waters of the pole toward the equator. We will not here solve the delicate problem, in what manner within the tropics, and in the temperate zone, for example in the Caribbean sea, and in the lakes of Switzerland, these inferior strata of water, cooled to 4° or 7° act upon the temperature of the stony strata of the globe which they cover; and how these same strata, the primitive temperature of which is under the tropics 27°, and at the lake of Geneva 10°, reäct upon the half-frozen waters at the bottom of the lakes, and of the Equinoctial Ocean. These questions are of the highest importance, both with regard to the economy of animals that live habitually at the bottom of fresh and salt waters, and to the theory of the distribution of heat in lands surrounded by vast and deep seas.

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* We shall see hereafter, that, according to observations made at Cumana on the produce of evaporation, the temperature of the water in vessels exposed to the Sun during seven or eight hours constantly remained, at the end of the experiment, from 1° to 1·8° below the temperature of the air in the shade.

† See above, vol. i, p. 38. I made the following observation, on the 16th of April, 1798, at four in the afternoon, on the lake of St. Bartholomew, in the Alps of Berchtesgaden, behind Falkenstein. Air, at the shore, therm. 17·7° cent.; hair-hygrometer 56°. Air at the centre of the lake, th. 16°; hyg. 68°. Water of the lake, at a depth of two feet, th. 7·7°; at forty-two feet, th. 6·2°; at sixty feet, th. 5°; and in another place, at eighty-four feet, therm. 5·6°.

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* This is the difference between the absolute elevations of the lake of Geneva and that of Thun.

† See vol. ii, p. 56; and Arago, in the *Annales de Physique*, vol. v, p. 403.

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* It is almost superfluous to observe, that I am considering here only that part of the atmosphere lying on the ocean between 10° of North and 10° of South latitude. Toward the northern limits of the torrid zone, in the latitude of 23°, whither the North winds bring with an extreme rapidity the cold air of Canada, the thermometer falls at sea as low as 16°, and even lower.

The lake of Valencia is full of islands, which embellish the scenery by the picturesque form of their rocks, and the appearance of the vegetation with which they are covered. This is an advantage, which this tropical lake possesses over those of the Alps. The islands are fifteen in number distributed in three groups*; no longer reckoning Morro and Cabrera, which are already joined to the shore. They are partly cultivated, and extremely fertile on account of the vapours, that rise from the lake. Burro, the largest of these islands, is two miles in length; and even inhabited by some families of Mestizoes, who rear goats. These simple men seldom visit the shore of Mocundo. To them the lake appears of immense extent; they have plantains, cassava, milk, and a little fish. A hut constructed of reeds; hammocks woven with the cotton, which the neighbouring fields produce; a large stone, on which the fire is made, the ligneous fruit of the tutuma, in which they draw water; constitute their domestic establishment. The old Mestizo, who offered some of the milk of his goats, had a beautiful daughter. We learned from our guide, that solitude had rendered him as mistrustful, as he might perhaps have been made by the society of men. The day before our arrival, some sportsmen had visited the island. They were surprised by the night; and preferred sleeping in the open air to returning to Mocundo. This news spread alarm throughout the island. The father obliged the young girl to climb up a very lofty zamang or

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* The position of these islands is as follows: to the North, near the shore, *Isla de Cura*; to the South-East, *Burro*, *Horno*, *Otama*, *Sorro*, *Caiguira*, *Nueves Penones* or the new *Aparecidas*; to the North-West, *Cabo-Blanco*, or *Isla de*

Aves, and *Chamberg*; to the South-West, *Brucka* and *Culebra*. In the centre of the lake, rise, like shoals or small detached rocks, *Vagre*, *Fraile*, *Penasco*, and *Pan de Azucar*.

acacia, which grows in the plain, at some distance from the hut; while he stretched himself at the foot of the tree, and did not permit his daughter to descend, till the sportsmen had departed. Travellers have not always found this timorous watchfulness, this great austerity of manners, among the inhabitants of islands.

The lake is in general well stocked with fish; though it furnishes only three kinds, the flesh of which is soft and insipid, the *guavina,* the *vagra,* and the *sardina.* The two last descend into the lake by the streams that flow into it. The guavina, of which I made a drawing on the spot, is twenty inches long, and 3·5 thick. It is perhaps a new species of the genus erythrina of Gronovius. It has large silvery scales, edged with green. This fish is extremely voracious, and destroys the other kinds. The fishermen assured us, that a small crocodile, the *bava* *, which often approached us when we were bathing, contributes also to the destruction of the fish. We never could succeed in procuring this reptile, so as to examine it near: it generally attains only three or four feet in length. It is said to be very harmless; it's habits however, as well as it's form, much resemble those of the alligator, or crocodilus acutus. It swims in such a manner as to show only the point of it's snout, and the extremity of it's tail; and places itself at mid-day on the bare beach. It is certainly neither a monitor (the real monitors living only in the old continent), nor the *sauvegarde* of Seba (*lacerta teguim*), which dives, and does not swim*. Other travellers will decide that question; we shall here content ourselves with observing, it is somewhat remarkable, that the lake of Valencia, and the whole system of small rivers, which flow into it, have no large alligators, though this dangerous animal abounds a few leagues off in the streams, that flow either into the Apure, or the Oroonoko, or immediately into the Caribbean sea, between Porto Cabello and La Guayra.

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* The *bava,* or *bavilla,* is very common at Bordones, near Cumana. See above, vol. ii, p. 47 and 211. The name of bava *(baveuse)* has singularly misled Mr. Depons; he takes this reptile for a fish of our seas, the *blennius pholis. (Voyage à la Terre Ferme,* vol. iv, p. 142). [The *blennius pholis,* smooth blenny, is called by the French *baveuse* (slaverer), in Spanish *baba.* —Ed.]

In the islands that rise like bastions in the midst of the waters, and wherever the rocky bottom of the lake is visible to the eye, I recognized a uniform direction† in the strata of gneiss. This direction is nearly that of the chains of mountains on the North and South of the lake. In the hills of Cabo Blanco, angular masses of opake quartz, scarcely translucid on the edges, and varying from gray to deep black, are found amid the gneiss. It passes sometimes into hornstein, sometimes into *kieselschiefer* (schistoid jasper). I do not think it constitutes a vein. The waters of the lake* decompose the gneiss by erosion in a very extraordinary manner. I have found parts of it porous, almost cellular, and split in the form of cauliflowers, fixed on gneiss perfectly compact. Perhaps the action ceases with the movement of the waves, and the alternate contact of air and water.

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* Cuvier, *Regne animal*, 1817, vol. ii. p. 26, 27.

† Direction of the rock hor. 3—4. Dip toward the North-West. The mountains of the coast, and those of La Villa de Cura, lie W. S. W. and E. N. E.

The island of Chamberg is remarkable for it's height. It is a rock of gneiss, with two summits joined in the form of a saddle, and raised two hundred feet above the surface of the water. The slope of this rock is barren, and can scarcely support a few plants of clusia with large white flowers. But the view of the lake, and of the richly cultivated neighbouring valleys, is admirable; particularly after sunset, when thousands of aquatic birds, herons, flamingoes, and wild ducks, cross the lake to roost in the islands, and the broad zone of mountains, that surround the horizon, is covered with fire. The inhabitants, as we have already mentioned, burn the meadows in order to produce fresher and finer grass. Gramineous plants abound, especially at the summit of the chain; and those vast conflagrations extend sometimes over a length of a thousand toises, and appear like streams of lava overflowing the ridge of the mountains. When reposing on the banks of the lake in one of those beautiful evenings peculiar to the tropics, to enjoy the soft freshness of the air, it is delightful to contemplate, in the waves that beat the shore, the image of the red fires that inflame the horizon.

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* The water of the lake is not salt, as is asserted at Caraccas. It may be drunk without having been filtered. On evaporation it leaves a very small residuum of carbonat of lime, and perhaps a little nitrat of potash. It is even surprising, that an inland lake should not be richer in alcaline and earthy salts, acquired from the neighbouring soils. *Halley*. *Phil. Trans*. 1715, p. 295.

Among the plants, which the rocky islands of the lake of Valencia produce, many have been believed to be peculiar to those spots, because till now they have not been discovered elsewhere. Such are *the papaw-trees of the lake*; and the love-apples * of the island of Cura. The latter differ from our solanum lycopersicum; their fruit is round and small, but has a fine flavour; they are now cultivated at La Victoria, at Nueva Valencia, and every where in the valleys of Aragua. The papaw-tree (*papaya de la laguna)* abounds also in the island of Cura, and at Cabo-blanco; it's trunk shoots higher than that of the common papaw *(carica papaya)*, but it's fruit is only half as large, perfectly spherical, without projecting ribs, and four or five inches in diameter. When cut open, it is found quite filled with seeds, and without those hollow places, which occur constantly in the common papaw. The taste of this fruit, of which I have often eaten, is extremely sweet *. I know not whether it be a variety of the carica microcarpa, described by Jacquin.

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* The tomatoes are cultivated, as well as the papaw-tree of the lake, in the Botanical Garden of Berlin, to which I had sert some seeds. Mr. Willdenow has described and delineated this solanum, under the name of solanum Humboldtii, in the *Hortus Beral.*, p. 27, tab. 27.

The environs of the lake are unhealthful only in times of great drought, when the waters in their retreat leave a muddy sediment exposed to the ardour of the Sun. The banks, shaded by tufts of coccoloba barbadensis, and decorated with fine lilaceous plants †, remind us, by the appearance of the aquatic vegetation, of the marshy shores of our lakes in Europe. We find there, pondweed (potamogeton), chara, and cat's-tails three feet high, which it is difficult not to confound with the typha angustifolia of our marshes. It is only after a careful examination, that we recognize each of these plants for distinct species *, peculiar to the new continent. How many plants of the Straits of Magellan, of Chili, and the Cordilleras of Quito, have anciently been confounded, on account of their analogy in form and appearance, with the productions of the northern temperate zone!

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* They attribute to them a binding quality, and the people call them *tapaculo*.

† Pancratium *undulatum,* amaryllis *nervosa.* See our *Nov. Gen.*, vol. i, p. 278.

The inhabitants of the valleys of Aragua often inquire, why the southern shore of the lake, particularly the South-West part toward Aguacates, is generally more shaded, and of fresher verdure, than the northern side. We saw, in the month of February, many trees stripped of their foliage, near the Hacienda de Cura, at Mocundo, and at Guacara; while to the South-East of Valencia every thing presaged the approach of the rains. I believe, that in the early part of the year, when the Sun has southern declination, the hills that surround Valencia, Guacara, and Cura, are scorched by the ardour of the solar rays; while the southern shore receives with the breeze, when it enters the valley by the *Abra de Porto Cabello*, an air that has crossed the lake, and is loaded with aqueous vapour. On this southern shore, near Guaruto, the finest plantations of tobacco in the whole province are found. They are distinguished by the names of *primera*, *segunda*, and *tercera fundacion*. From the oppressive monopoly of the royal farm, which we have already noticed in describing the town of Cumanacoa *, the inhabitants of the province of Caraccas are allowed to cultivate tobacco only in the valleys of Aragua (at Guaruto and Tapatapa), and in the Llanos, near Uritucu. The produce of the sale is from five to six hundred thousand piastres; but the administration of the farm is so enormously expensive, that it absorbs nearly two hundred and thirty thousand piastres a year. The capitania-general of Caraccas, from the extent and excellent quality of it's soil, could furnish, as well as the island of Cuba, all the markets of Europe; but in it's present state it receives tobacco from Brazil, smuggled by way of the Rio Negro, the Cassiquiare, and the Oroonoko; and from the province of Pore, by the Casanare, the Ariporo, and the Rio Meta. Such are the fatal effects of a prohibitory system, which opposes the progress of agriculture, diminishes the riches of nature, and attempts in vain to separate countries traversed by the same rivers, and the limits of which are confounded together in uninhabited spaces.

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* Potamogeton *tenuifolium*, chara *compressa*, typha *tenuifolia*. Ib. vol. i, p. 45, 83, and 370.

Among the rivers flowing into the lake of

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* Ch. vi. vol. iii, p. 57.

Valencia some owe their origin to thermal springs, and deserve particular attention. These springs gush out at three points of the granitic Cordillera of the coast; near Onoto, between Turmero and Maracay; near Mariara, to the North-East of the Hacienda de Cura; and near Las Trincheras, on the road from Nueva Valencia to Porto Cabello. I could examine with care only the physical and geological relations of the thermal waters of Mariara and Las Trincheras. In going up the small river Cura toward it's source, the mountains of Mariara are seen advancing into the plain in the form of a vast amphitheatre, composed of perpendicular rocks, crowned by peaks with rugged summits. The central point of the amphitheatre bears the strange name of the Devil's Wall or Nook *(Rincon del Diablo)*. The range stretching to the East is called *El Chaparro;* that to the West, *Las Viruelas*. These rocks, in ruins, command the plain; they are composed of a coarse-grained granite, nearly porphyritic, the yellowish white feld-spar crystals of which are more than an inch and a half long. The mica is rare in them, and of a fine silvery lustre. Nothing can be more picturesque and solemn than the aspect of this group of mountains, half-covered with vegetation. The peak of Calavera, which unites the *Devil's Wall* to Chaparro, is visible from afar. In it the granite is separated by perpendicular fissures into prismatic masses. It would seem as if the primitive rock were crowned with columns of basaltes. In the time of rains, a considerable sheet of water rushes in the form of a cascade from these cliffs. The mountains connected toward the East with the *Devil's Wall* are much less lofty, and contain, like the promontory of La Cabrera, and the little distinct hills in the plain, gneiss and mica-slate, including garnets.

It is in these lower mountains, two or three miles North-East of Mariara, we find the ravine of hot waters, *quebrada de aguas calientes.* This ravine, running N. 75° W., contains several small basins. Of these the two uppermost, which have no communication with each other, are only eight inches in diameter; the three lower, from two to three feet. Their depth varies from three to fifteen inches. The temperature of these different funnels *(pozos)* is from 56° to 59° cent.; and, what is remarkable, the lower funnels are hotter than the upper, though the difference of the level is only seven or eight inches. The hot waters, collected together, form a little rivulet, *(rio de aguas calientes,)* which, thirty feet lower, has a temperature of only 48°. In the seasons of great drought *, the time at which we visited the ravine, the whole body of the thermal waters forms a section of only twenty-six square inches. This is considerably augmented in the rainy season; the rivulet is then transformed into a torrent, and it's heat diminishes; for it appears, that the hot springs themselves are subject only to imperceptible variations. All these springs are slightly impregnated with sulphuretted hydrogen gas*. The smell of rotten eggs, peculiar to this gas, can be perceived only by approaching very near the springs. In one of these wells only, the temperature of which is 56·2°, an extrication of bubbles of air occurs, and takes place at nearly regular intervals of two or three minutes. I observed, that these bubbles constantly rose from the same points, which are four in number; and that it was not possible to change the places, from which the gas is emitted, by stirring the bottom of the basin with a stick. These places correspond no doubt to holes or fissures in the gneiss; and indeed when the bubbles rise from one of the apertures, the emission of gas follows instantly from the other three. I could not succeed in inflaming the small quantities of gas, that rise above the thermal waters; or those which I had collected in a glass vial held over the springs, an operation that excited in me a nausea, caused less by the smell of the gas, than

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* The 18th February, 1800.

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† Hydrosulphuric acid.

by the excessive heat prevailing in this ravine. Is this sulphuretted hydrogen mixed with a great proportion of carbonic acid, or of atmospheric air? I am doubtful of the first of these mixtures, though so common in thermal waters (at Aix la Chapelle, Enghien, and Bareges). The gas collected in the tube of Fontana's eudiometer had been shaken for a long time with water. The small basins are covered with a light pellicle of sulphur, deposited by the sulphuretted hydrogen in it's slow combustion in contact with the atmospheric oxygen. A few plants near the springs were incrusted with sulphur. This deposite is scarcely visible, when the water of Mariara is suffered to cool in an open vessel; no doubt because the quantity of disengaged gas is very small, and is not renewed. The water when cold gives no precipitate with a solution of nitrat of copper; is destitute of flavour, and very drinkable. If it contain any saline substances, for example, sulphat of soda, or of magnesia, their quantities must be very insignificant. Being almost destitute of chemical tests*, we contented ourselves with filling two bottles at the very source, which were sent, along with the nourishing milk of the tree called *vaca*, to Messrs. Fourcroy and Vauquelin, by the way of Porto-Cabello and the Havannah. This purity in hot waters issuing immediately from granitic mountains is one of the most curious phenomena, which the two continents display*. How can we explain the origin of the hydrosulphuretted gas? It cannot proceed from the decomposition of sulphurets of iron, or pyritic strata. Is it owing to sulphurets of calcium, of magnesium, or other earthy metalloids, contained in the interior of our planet, under it's rocky and oxidated crust?

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* A small case, containing acetat of lead, nitrat of silver, alcohol, prussiat of potash, &c., had been left by mistake at Cumana. I evaporated some of the water of Mariara, and it yielded only a very small residuum, which, digested with nitric acid, appeared to contain only a little silica and extractive vegetable matter.

In the ravine of the hot waters of Mariara, amid little funnels the temperature of which rises from 56° to 59°, two species of aquatic plants vegetate; the one is membranaceous, and contains bubbles of air; the other has parallel fibres†. The first much resembles the ulva labyrinthiformis of Vandelli, which the thermal waters of Europe furnish. At the island of Amsterdam Mr. Barrow‡ has seen tufts of lycopodium and marchantia in places, where the heat of the soil was far greater. Such is the effect of an *habitual stimulus* on the organs of plants. The waters of Mariara contain no aquatic insects. Frogs are found in them, which, chased by serpents, have leaped into the funnels, and there perished.

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* In the ancient continent warm waters equally pure are found gushing out from the granites of Portugal, and those of Cantal. In Italy, the Pisciarelli of the lake Agnano have a temperature equal to 93° cent. Are these pure waters the product of condensed vapours?

† *Conferva? fibrosa, laete viridis, fibris parallelis, indivisis, apicem versus attenuatis.*

‡ Voyage to Cochinchina, p. 143.

South of the ravine, in the plain that extends toward the shore of the lake, another hydrosulphurous spring gushes out, less hot, and more feebly impregnated with gas. The crevice, whence this water issues, is six toises higher than the funnel just described. The thermometer did not rise in the crevice above 42°. The water is collected in a basin surrounded by large trees, nearly circular, from fifteen to eighteen feet diameter, and three feet deep. The unhappy slaves throw themselves into this bath at the end of the day, when covered with dust, having worked in the neighbouring fields of indigo and sugar-canes. Though the water of this *bano* is habitually from 12° to 15° hotter than the air, the Blacks call it refreshing; because in the torrid zone this term is used for whatever restores strength, calms the irritation of the nerves, or causes a feeling of comfort. We ourselves found the salutary effects of the bath. We hung our hammocks from the trees that shade the basin, and passed a whole day in this charming spot, which abounds in plants. We found near the *bano* of Mariara the *volador* or gyrocarpus. The winged fruits of this large tree turn like a fly-wheel, when they fall from their stalk. On shaking the branches of the *volador*, we saw the air filled with it's fruits, the simultaneous fall of which presents the most singular spectacle. The two membranaceous and striated wings are turned so as to meet the air, in falling, at an angle of 45°. Fortunately the fruits we gathered were at their maturity. We sent some to Europe, and they have germinated in the gardens of Berlin, Paris, and Malmaison. The numerous plants of the *volador*, now found in hot-houses, owe their origin to the only tree of the kind found near Mariara. The geographical distribution of the different species of gyrocarpus, which Mr. Brown considers as a laurinea, is very singular. Jacquin saw one species near Carthagena in America *. This is the same which we met with again in Mexico, near Zumpango, on the road from Acapulco to the capital †. Another species, that grows on the mountains of Coromandel *, has been described by Roxburgh: the third and fourth † grow in the southern hemisphere, on the coasts of New Holland.

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* *Jacq., Hist. Amer.*, t. 178, f. 80. This is the gyrocarpus Jacquini of Gærtner (De Fruct., t. 97, vol. ii, p. 92), or gyrocarpus americanus, Willd.

† The natives of Mexico called it *quitlacoctli*. I saw some of it's young leaves, with three and five lobes; the full grown leaves are in the form of a heart, and constantly with three lobes. We never met with the volador in flower Messrs. Sesse and Mocino have drawings of it.

After getting out of the bath, while, half-wrapped in a sheet, we were drying ourselves in the Sun, according to the custom of the country, a little man of the mulatto race approached us. After bowing gravely, he made us a long speech on the virtues of the waters of Mariara, on the numbers of sick by whom they have been visited for some years past, and on the fortunate situation of the springs between two towns, Valencia and Caraccas, where the neglect of moral conduct is encreasing every day. He showed us his house, a little hut covered with palm-leaves, and situate in an enclosure at a small distance, on the bank of a rivulet, that communicates with the bath. He assured us, that we should there find all the conveniences of life; nails to suspend our hammocks, ox-leather to stretch over benches made of reeds, earthen vases always filled with cool water, and what, after the bath, would be most salutary to us of all, those great lizards (iguanas), the flesh of which is known to be a refreshing aliment. We judged from his ha-

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* *Roxb. Corom., I, pl. t.* 1. This is the gyrocarpus asiaticus, Willd.

† G. sphenopterus, and g. rugosus. (Brown, Prodr. vol. 1, p. 405).

rangue, that the poor man took us for sick persons, who were come to stay near the spring. His counsels and offers of hospitality were not altogether disinterested. He entitled himself "the inspector of the waters, and *pulpero*[*] of the place." Accordingly all his obliging attentions to us ceased, as soon as he heard, that we were simply come to satisfy our curiosity; or as they express it in the colonies, which are the land of idleness, *para ver, no mas,* "to see and nothing more."

The waters of Mariara are used with success in rheumatic swellings, old ulcers, and those horrible affections of the skin called *bubas,* the origin of which is not always siphylitic. As the waters are but very feebly impregnated with sulphuretted hydrogen, it is necessary to bathe at the spot whence they gush out. Farther on, these small waters are employed for the irrigation of fields of indigo. The wealthy proprietor of Mariara, Don Domingo Tovar, had formed the project of erecting a bathing-house, and an establishment, which would furnish people in easy circumstances with a few more resources than lizard's flesh for food, and leather stretched on a bench for their repose.

On the 21st of February in the evening we set out from the beautiful *Hacienda de Cura* for Guacara and Nueva Valencia. We preferred travelling by night, on account of the excessive heat of the day. We passed by the hamlet of Punta Zamuro, at the foot of the high mountains of Las Viruelas. The road is bordered with large zamang trees or mimosas, the trunks of which rise to sixty feet high. Their branches, nearly horizontal, meet at more than one hundred and fifty feet distance. I have no where seen a vault of verdure more beautiful and luxuriant. The night was gloomy: the Devil's Wall and it's denticulated rocks appeared from time to time at a distance, illumined by the burning of the savannahs, or wrapped in ruddy smoke. At the spot where the bushes were the thickest, our horses were frightened by the yell of an animal, that seemed to follow us closely. It was a large tiger, that had roamed for three years among these mountains. He had constantly escaped the pursuits of the boldest hunters; and had carried off horses and mules from the midst of enclosures; but, having no want of food, had not yet attacked men. The Negro, who conducted us, uttered wild cries. He thought he should frighten the tiger; but these means were of course without effect. The jaguar, like the wolf of Europe, follows travellers, even when he will not attack them; the wolf in the open fields, and in unsheltered places; the jaguar skirting the road, and appearing only at intervals between the bushes.

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[*] Proprietor of a *pulperia,* or little shop, where eatables and drinkables are sold.

We passed the day on the 23d in the house of the Marquis de Toro, at the village of Guacara, a very considerable Indian community. The natives, of whom the corregidor, Don Pedro Penalver, was a man distinguished by the cultivation of his mind, were in tolerably easy circumstances. They had just gained a cause at the Audiencia, that replaced them in the possession of some lands, the property of which had been contested by the Whites. An avenue of carolineas leads from Guacara to Mocundo. It was the first time that I had seen in the open air this majestic plant, which forms one of the principal ornaments of the extensive hot-houses of Schoenbrunn *. Mocundo is a rich plantation of sugar-canes, belonging to the family of Toro. We there find, what is so rare in that country, even a "luxury of agriculture," a garden, artificial clumps of trees, and on the border of the water, upon a rock of gneiss †, a pavilion with a *mirador*, or belvidera. The view is delightful over the western part of the lake, the surrounding mountains, and a forest of palm-trees, that separates Guacara from the city of Nueva Valencia. The fields of sugar-cane, from the soft verdure of the young reeds, resemble a vast meadow. Every thing denotes abundance; but it is at the price of the liberty of the cultivators. At Mocundo, with two hundred and thirty Negroes, seventy-seven *tablones*, or cane-fields, are cultivated, each of which, ten thousand *varas* square [*], yields a clear produce of two hundred or two hundred and forty piastres a year. The creole cane and the cane of Otaheite [†] are planted in the month of April, the first at four, the second at five feet distance. The cane ripens in fourteen months. It flowers in the month of October, if the plant be sufficiently vigorous; but the top is cut off before the panicle is unfolded. In all the monocotyledonous plants (the maguey cultivated at Mexico for extracting the *pulque*, the wine-yielding palm-tree, and the sugarcane), the flowering alters the quality of the juices. The fabrication of sugar, the boiling, and the claying, are very imperfect in Terra Firma, because it is made only for home consumption; and for wholesale the *papelon* is preferred to sugar, either refined or raw. The *papelon* is an impure sugar, in the form of little loaves, of a yellow brown colour. It contains a mixture of melasses and mucilaginous matter. The poorest man eats *papelon*, as in Europe he eats cheese. It is believed to have nutritive qualities. Fermented with water, it yields the *guarapo*, the favorite beverage of the people. In the province of Caraccas, subcarbonat of potash is used, instead of lime, to purify the juice of the sugarcane. The ashes of the *bucare*, which is the erythrina corallodendron, are preferred.

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* Every tree of the carolinea princeps at Schoenbrunn has sprung from seeds collected by Messrs. Bosc and Brudemeyer from one single tree, of an enormous size, near Chacao, East of Caraccas.

† Direction of the strata of gneiss, hor. 3—4. Dip 80° to the South-East.

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[*] A *tablon*, equal to 1849 square toises, contains nearly an acre and one fifth; for a legal acre has 1344 square toises, and 1·95 legal acre is equal to one hectare.

[†] At the island of Palma, where in the latitude of 29° the sugarcane is cultivated, according to Mr. de Buch, as high as 140 toises above the level of the Atlantic, the Otaheite cane requires more heat than the creole cane.

The sugarcane was introduced very late, probably toward the end of the sixteenth century, from the West India islands into the valleys of Aragua. Known in India, in China, and all the islands of the Pacific ocean, from the most remote antiquity, it was planted in Persia, in Chorasan, as early as the fifth century of our era, in order to obtain from it solid sugar*. The Arabs carried this reed, so useful to the inhabitants of hot and temperate countries, the shores of the Mediterranean. In 1306, it's cultivation was yet unknown in Sicily; but was already common in the island of Cyprus, at Rhodes, and in the Morea[*]. A hundred years after it enriched Calabria, Sicily, and the coasts of Spain. From Sicily the Infant Henry transplanted the cane to Madeira[†]: from Madeira it passed to the Canary islands, where it was entirely unknown; for the *ferulæ* of Juba *(quæ expressæ liquorem fundunt potui jucundum)* are euphorbiums, the *tabayba dulce*, and not, as has been recently asserted[‡], sugarcanes. Twelve sugar-manufactories *(ingenios de azucar)* were soon established in the island of Great Canary, in that of Palma, and between Adexe, Icod, and Guarachico, in the island of Teneriffe. Negroes were employed in this cultivation, and their descendants still inhabit the grottoes of Tiraxana, in the Great Canary. Since the sugarcane has been transplanted to the West Indies, and the New World has given maize to the Canaries, the cultivation of this latter has taken the place of the cane at Teneriffe, and the Great Canary. This is now found only in the island of Palma, near Argual and Tazacorte[*], where it yields scarcely one thousand quintals of sugar a year. The sugarcane of the Canaries, which Aguilon transported to St. Domingo, was there cultivated extensively as early as 1513, or in the six or seven following years, under the auspices of the monks of St. Jerome[†]. Negroes were employed in this cultivation from it's commencement; and in 1519 representations were already made to government, as in our own time, " that the West India islands would be ruined and remain desert, if slaves were not conveyed thither annually from the coast of Guinea"[‡].

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* See my researches on *sugar*, and the *tabasheer*, the Indian name of which, *scharkara*, has passed into sugar, in the *Nov. Gen. et Species Plant.*, vol. i, p. 243.

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[*] According to the collection known under the name of *Bongars, Gesta Dei per Francos (Sprengel, Gesch. der Geogr. Entdeckungen*, p. 186). *Alexandri Benedicti Opera med.*, 1549, p. 150.

[†] Ramusio, vol. i, p. 106.

[‡] On the Origin of Cane Sugar, in the *Journ. de Pharmacie*, 1816, p. 387. The *tabayba dulce* is, according to Mr. von Buch, the euphorbia balsamifera, the juice of which is neither corrosive nor bitter, like that of the *cardon*, or euphorbia canariensis.

For some years past the culture and fabrication of sugar has been much improved in Terra Firma; and, as the process of refining is not permitted by the laws at Jamaica, they reckon on the fraudulent exportation of refined sugar to the English colonies. But the consumption of the provinces of Venezuela, either in *papelon*, or in raw sugar employed for the fabrication of chocolate and sweet-meats *(dulces)*, is so enormous, that the exportation has been hitherto entirely null. The finest plantations of sugar are in the valleys of Aragua, and of the Tuy [*], near Pao de Zarate, between La Victoria and San Sebastian [†], near Guatire, Guarenas, and Caurimare [‡]. If the first canes arrived in the New World from the Canary islands, it is also in general Canarians, or *Islengos*, who are now placed at the head of the great plantations, and who superintend the labours of cultivation and refining.

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[*] *Notice sur la Culture du Sucre dans les Isles Canaries*, by Mr. Leopold von Buch. (MS.)

[†] Herrera, Dec. ii, b. 3, c. 14. Compare my *Essai Politique sur la Nouv. Espagne*, tom. 2, p. 425.

[‡] Dec. ii, b. 3, Herera, c. 3.

It is this intimate connexion between the Canarians and the inhabitants of Venezuela, that has given rise to the introduction of camels into those provinces. The Marquis del Toro caused three to be brought from Lancerota. The expense of conveyance was very considerable, on account of the space which these animals occupy on board merchant-vessels, and of the great quantity of water of which they stand in need, in the state of suffering to which they are reduced by a long passage. A camel, bought for thirty piastres, costs between eight and nine hundred on arriving on the coast of Caraccas. We saw four of these animals at Mocundo;

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[*] Tapatapa, or La Trinidad, Cura, Mocundo, El Palmar.

[†] For instance, the Hacienda de Santa Rosa.

[‡] Price in the valleys of Aragua: a *papelon*, or loaf of two pounds and a half weight, half a real de plata, or one sixteenth of a piastre; one pound of raw sugar, one real; one pound of clayed sugar, from one real to one and a half.

three of which had already been born in America; and two had died of the bite of the *coral*, a venomous serpent very common on the banks of the lake. These camels have hitherto been employed only in the conveyance of the sugar-canes to the mill. The males, stronger than the females, carry from forty to fifty arrobas. A wealthy landholder in the province of Varinas, encouraged by the example of the Marquis del Toro, has allotted a sum of 15,000 piastres for the purpose of bringing fourteen or fifteen camels at once from the Canary islands. Such enterprises are so much the more laudable, as it is presumed these beasts of burden may be employed in the conveyance of merchandize across the burning plains of Casanare, from the Apure and Calabozo, which in the season of drought resemble the deserts of Africa. I have already observed in another place * how much it were to be wished, that the *Conquistadores*, from the beginning of the sixteenth century, had peopled America with camels, as they have peopled it with horned cattle, horses, and mules. Wherever there are immense distances to cross in uninhabited lands; wherever the construction of canals becomes useless, because they require too great a number of locks (as in the isthmus of

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* Essai Politique sur la Nouv. Espagne, vol. i, p. 23; vol. ii, p. 689.

Panama, on the table-land of Mexico, and in the deserts that separate the kingdom of Quito from Peru, and Peru from Chili), camels would be of the highest importance, to facilitate inland commerce. It seems the more surprising, that their introduction was not encouraged by the government at the beginning of the conquest, as, long after the taking of Grenada, camels, for which the Moors had a great predilection, were still very common in the South of Spain. A Biscayan, Juan de Reinaga, carried some of these animals at his own expense to Peru. Father Acosta * saw them at the foot of the Andes, toward the end of the sixteenth century; but little care being taken of them, they scarcely ever bred, and the race soon became extinct. In those times of oppression and calamity, which have been described as the times of Spanish glory, the commendataries *(encomenderos)* let out the Indians to travellers like beasts of burden. They were assembled by hundreds, either to carry merchandize across the Cordilleras, or to follow the armies in their expeditions of discovery and pillage. The Indians endured this service more patiently, because, on account of the almost total want of domestic animals, they had long been constrained to perform it, though in a less inhuman manner, under the government of

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† *Hist. Nat. de Indias*, lib. iv, c. 33.

their own chiefs. The introduction of camels attempted by Juan de Reinaga spread an alarm among the *encomenderos,* who were, not agreeably to the laws, but in fact, lords of the Indian villages. We cannot be surprised, that the court listened to the complaints of the Lords; but in consequence of this measure America was deprived of one of the means, which would most have facilitated it's inland communication, and the exchange of productions. Now that the Indians, since the reign of Charles III, are governed according to a more equitable system, and as a larger field is about to be opened for all the branches of national industry, the introduction of camels should be attempted as a general measure, and by the government itself. A few hundreds of these useful animals, spread over the vast surface of America, in hot and barren places, would in a few years have a powerful influence on the public prosperity. Provinces separated by *steppes* would then appear to be brought nearer to each other; several kinds of inland merchandize would diminish in price on the coast; and by increasing the number of camels, above all the *hedjines,* or *ships of the desert,* a new life would be given to the industry and commerce of the New World.

On the evening of the 22d we continued our journey from Mocundo by Los Guayos to the city of Nueva Valencia. We passed a little forest of palm-trees, which resembled by their appearance, and their leaves spread like a fan, the chamerops humilis of the coast of Barbary. The trunk however rises to twenty-four and sometimes thirty feet high. It is probably a new species of the genus corypha *; and is called in the country *palma de sombrero*, the footstalks of the leaves being employed in weaving hats, that resemble our straw hats. This grove of palm-trees, the withered foliage of which rustles at the least breath of air; the camels, that feed in the plain; the undulating motion of the vapours on a soil burnt by the ardour of the Sun; give the landscape an African aspect. The aridity of the land augments as the traveller approaches the town, after passing the western extremity of the lake. It is a clayey soil, that has been levelled and abandoned by the waters. The neighbouring hills, called the *Morros de Valencia*, are composed of white tufas, a very recent limestone formation, immediately covering the gneiss. It is again found at Victoria, and on several other points along the chain of the coast. The whiteness of these tufas, which reflect the rays of the Sun, contribute greatly to the excessive heat felt in this place. Every thing seems smitten with sterility; scarcely are a few plants of cacao found on the banks of the Rio de Valencia; the rest of the plain is bare, and destitute of vegetation. This appearance of sterility is here attributed, as it is every where in the valleys of Aragua, to the cultivation of indigo; which, according to the planters, is, of all plants, that which most exhausts (*cansa*, 'fatigues') the ground. The real physical causes of this phenomenon would be an interesting inquiry; since, like the effects of fallowing land, and of a rotation of crops, it is far from being sufficiently understood. I shall only observe in general, that the complaints of the increasing sterility of cultivated land become more frequent between the tropics, in proportion as they are near the period of their first breaking up. In a region almost destitute of herbs; where every plant has a ligneous stem, and tends to raise itself as a shrub; the virgin soil remains shaded either by great trees, or by bushes; and under this tufted shade it preserves every where coolness and humidity. However active the vegetation of the tropics may appear, the number of roots, that penetrate into the earth, is not so great in an uncultivated soil; while the plants are nearer to each other in lands subjected to cultivation, and covered with indigo, sugarcanes, or cassava. The trees and shrubs, loaded with branches and leaves, draw a great part of their nourishment from the ambient air; and the virgin soil augments it's fertility by the decomposition of the vegetable substances, which progressively accumulate. It is not so in the fields covered with indigo, or other herbaceous plants; where the rays of the Sun penetrate freely into the earth, and by the accelerated combustion of the hydrurets of carbon, and other acidifiable principles, destroy the germes of fecundity. These effects strike the imagination of the planters the more forcibly, as in lands newly inhabited they compare the fertility of a soil, which has been abandoned to itself during thousands of years, with the produce of ploughed fields. The Spanish colonies on the continent, and the great islands of Porto-Rico and Cuba, possess remarkable advantages with respect to the produce of agriculture over the Little West India islands. The former, from their extent, the variety of their scenery, and their small relative population, still bear all the characters of a new soil; while at Barbadoes, Tobago, St. Lucia, the Virgin Islands, and the French part of St. Domingo, it may be perceived, that long cultivation has begun to exhaust the soil. If in the valleys of Aragua, instead of abandoning the indigo grounds, and leaving them fallow, they were covered during several years, not with corn, but with other alimentary plants and forage; if among these plants such as belong to different families were preferred, and which shade the soil by their large leaves; the melioration of the fields would be gradually accomplished; and they would be restored to a part of their former fertility.

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* Corypha *tectorum*; *Nova Gen.*, vol. i, p. 299.

The city of Nueva Valencia occupies a considerable extent of ground, but it's population scarcely amounts to six or seven thousand souls. The streets are very broad, the dimensions of the market place, *plaza major*, are excessive; and, the houses being low, the disproportion between the population of the town, and the space that it occupies, is still greater than at Caraccas. Many of the Whites, above all the poorest, forsake their houses, and live the greater part of the year in their little plantations of indigo and cotton, where they can venture to work with their own hands; which, according to the inveterate prejudices of that country, would be a disgrace to them in the town. The industry of the inhabitants begins in general to awaken; and the cultivation of cotton has considerably augmented, since new privileges have been granted to the trade of Porto Cabello, and since that port has been opened as a *principal port* *, to vessels that come directly from the mother country.

Nueva Valencia, founded in 1555 under the government of Villacinda, by Alonzo Diaz Moreno, is twelve years older than Caraccas. We have already shown elsewhere, that the Spanish population spread in Venezuela from West to East. Valencia was at first only a dependancy of Burburata; but this latter town is nothing now but a place of embarkation for mules. It is regretted, and perhaps justly, that Valencia has not become the capital of the country. It's situation in a plain, on the banks of a lake, recalls to mind the position of Mexico. When we reflect on the easy communication, which the valleys of Aragua furnish with the Llanos, and the rivers that flow into the Oroonoko; when we recognize the possibility of opening an inland navigation, by the Rio Pao and the Portuguesa, as far as the mouths of the Oroonoko, the Cassiquiare, and the Amazon; it may be conceived, that the capital of the vast provinces of Venezuela would have been better placed near the fine harbour of Porto Cabello, beneath a pure and serene sky, than near the unsheltered road of La Guayra, in a temperate but constantly foggy valley. Near the kingdom of New Granada, and situate between the fertile corn-lands of La Victoria and Barquesimeto, the city of Valencia ought to have prospered; but, notwithstanding these advantages, it has been unable to maintain the contest with Caraccas, which during two centuries has borne away a great number of it's inhabitants. The families of Mantuanoes have preferred a residence in the capital to that of a provincial town.

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* *Puerto mayor*, since 1798.

Those who do not know the immense quantity of ants, that infest every country within the torrid zone, can scarcely form an idea of the destruction, and of the sinking of the ground occasioned by these insects. They abound to such a degree on the spot where Valencia is placed, that their excavations resemble subterraneous canals, which are filled with water in the time of the rains, and become very dangerous to the buildings. Here recourse has not been had to the extraordinary means employed at the beginning of the sixteenth century in the island of St. Domingo, when troops of ants ravaged the fine plains of La Vega, and the rich possessions of the order of St. Francis. The monks, after having in vain burnt the larvæ of the ants, and had recourse to fumigations, advised the inhabitants to choose by lot a saint, who would serve as an *abagado contra las hormigas* *. The honour of the choice fell on St. Saturnin; and the ants disappeared, as soon as the first festival of this saint was celebrated. Incredulity has made great progress since the time of the conquest; and it was on the back of the Cordilleras only, that I found a small chapel, destined, according to it's inscription, for prayers to be addressed to Heaven for the destruction of the *termites*.

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* *Herrera, Decad.* II, l. 3, c. 14.

Valencia affords some historical remembrances; but these, like every thing connected with the colonies, have no remote date, and recall to mind either civil discords, or sanguinary conflicts with the savages. Lopez de Aguirre, whose crimes and adventures form one of the most dramatic episodes of the history of the *conquest*, went, in 1561, from Peru, by the river of Amazons, to the island of Margaretta; and thence, by the port of Burburata, into the valleys of Aragua. On his entrance into Valencia, which proudly entitles itself *the City of the King*, he proclaimed the independance of the country, and the deposition of Philip II. The inhabitants withdrew to the islands of the lake of Tacarigua, taking with them all the boats from the shore, to be more secure in their retreat. In consequence of this stratagem, he could exercise his cruelties only on his own people. He composed at Valencia that famous letter to the King of Spain, which paints with such frightful truth the manners of the soldiery of the sixteenth century *. The tyrant (Aguirre is still thus denominated by the vulgar) boasts alternately of his crimes and his piety; he gives advice to the King on the government of the colonies, and the system of missions. Surrounded by savage Indians, navigating on a great sea of fresh water, as he calls the river of Amazons, he is alarmed at the heresies of Martin Luther, and the increasing influence of schismatics in Europe. Lopez de Aguirre was killed at Barquesimeto, after having been abandoned by his own men. At the moment when he fell, he plunged a dagger into the bosom of his only daughter, "that she might not have to blush before the Spaniards at the name of the daughter of a traitor." *The soul of the tyrant* (such is the belief of the natives) wanders in the Savannahs, like a flame, that flies the approach of men *.

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* See note A, at the end of this book.

The second historical event connected with the name of Valencia is the great incursion made by the Caribbees of the Oroonoko in 1578 and 1580. That cannibal horde went up the banks of the Guarico, crossing the plains or *Llanos.* They were happily repulsed by the valour of Garcia Gonzalez, one of the captains whose names are still the most revered in those provinces. It is soothing to recollect, that the descendants of those very Caribbees now live in the missions as peaceable husbandmen, and that no savage nation of Guiana dares to cross the plains, that separate the region of the forests from that of cultivated land. The Cordillera of the coast is cut by several ravines, that are very uniformly directed from South-East to North-West. This phenomenon is general from the Quebrada of Tocume, between Petarez and Caraccas, as far as Porto Cabello. It would seem as if the impulsion had every where come from the South-East; and this fact is the more striking, as the strata of gneiss and mica-slate in the Cordilleras of the coast are generally directed from the South-West to the North-East. The greater part of these ravines penetrate into the mountains at their southern declivity, without crossing them entirely. But there is an opening *(abra)* in the meridian of Nueva Valencia, which leads toward the coast, and by which a cooling sea-breeze penetrates every evening into the valleys of Aragua. This breeze rises regularly two or three hours after sunset.

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* See above, vol. ii, p. 219, 220.

By this *abra*, the farm of Barbula, and an eastern branch of the ravine, a new road is constructing from Valencia to Porto Cabello. It will be so short, that it will require only four hours to reach the port, and the traveller will be able to go and return in the same day from the coast to the valleys of Aragua. In order to examine this road, we set out on the 26th of February in the evening for the farm of Barbula, accompanied by the proprietors of that farm, the amiable family of Arambary.

On the 27th in the morning we visited the hot springs of La Trinchera, three leagues from Valencia. The ravine is very large, and the descent almost continual from the banks of the lake to the sea-coast. La Trinchera takes it's name from little fortifications in earth, thrown up in 1677 by some French freebooters, who sacked the town of Valencia. The hot springs, which is a remarkable geological fact, do not gush out to the South of the mountains, like those of Mariara, Onoto, and the Brigantine; but they issue from the chain itself, almost at it's northern declivity. They are much more abundant than any we had till then seen, forming a rivulet, which in the times of the greatest drought is two feet deep and eighteen wide. The temperature of the water, measured with great care, was 90·3° of the centigrade thermometer. Next to the springs of Urijino, in Japan, which are asserted to be pure water at 100° of temperature, the waters of the Trinchera of Porto Cabello appear to be the hottest in the world. We breakfasted near the spring; eggs plunged into the thermal waters were boiled in less than four minutes. These waters, strongly charged with sulphuretted hydrogen, gush out from the back of a hill rising one hundred and fifty feet above the bottom of the ravine, and trending from South-South-East to North-North-West. The rock, from which the springs gush, is a real coarse-grained granite, resembling that of the *Devil's Wall* in the mountains of Mariara. Wherever the waters evaporate in the air, they form sediments and incrustations of carbonat of lime; perhaps they traverse strata of primitive limestone, so common in the mica-slate and gneiss of the coasts of Caraccas. We were surprised at the luxuriant vegetation that surrounds the basin; mimosas with slender pinnate leaves, clusias, and fig-trees, have pushed their roots into the bottom of a pool, the temperature of which is 85°, and the branches of these trees extended over the surface of the water, at two or three inches distance. The foliage of the mimosas, though constantly humectated with the hot vapours, displayed the most beautiful verdure. An arum, with a woody stem, and with large sagittate leaves, rose in the very middle of a pool, the temperature of which was 70°. The same species of plants vegetate in other parts of those mountains at the brink of torrents, the temperature of which is not 18°. What is still more singular, forty feet distant from the point, whence the springs gush out at a temperature of 90°, other springs are found entirely cold. They all follow for some time a parallel direction; and the natives showed us, that by digging a hole between the two rivulets, they could procure a bath of any given temperature they pleased. It seems remarkable, that in the hottest as well as the coldest climates, people display the same predilection for heat. On the introduction of Christianity into Iceland, the inhabitants would be baptized only in the hot springs of Hecla: and under the torrid zone, in the plains, as well as on the Cordilleras, the natives flock from all parts to the thermal waters. The sick, who come to La Trinchera to use vapour baths, form a sort of arbor over the spring with branches of trees and very slender reeds. They stretch themselves naked on this arbor, which appeared to me to possess little strength, and to be dangerous of access. The Rio de *Aguas Calientes* runs toward the North-East, and becomes, near the coast, a considerable river, peopled with great crocodiles, and contributing by it's inundations to the insalubrity of the shore.

We descended toward Porto Cabello, having constantly the river of hot water on our right. The road is extremely picturesque. The waters tumble down on the shelves of the rock. We seemed to gaze on the cascades of the Reuss, that flows down Mount St. Gothard; but what a contrast in the vigour and richness of the vegetation! The white trunks of the cecropia rise majestically amid bignonias and melastomas. They do not disappear till we are only one hundred toises above the level of the ocean. A small thorny palm-tree extends also to this limit; the slender pinnate leaves of which look as if they had been curled toward the edges. This tree is very common in these mountains;

but not having seen either it's fruit, or it's flowers, we are ignorant whether it be the *piritu* palm-tree of the Caribbees, or the cocos aculeata of Jacquin.

The rock on this road presents a geological phenomenon so much the more remarkable, as the existence of a real stratified granite has been long disputed. Between La Trinchera and the inn of Cambury a coarse-grained granite appears, which the disposition of the spangles of mica, collected in small groups, scarcely admits of confounding with the gneiss, or with rocks of a schistose texture. This granite, divided into ledges of two or three feet thick, is directed N. 52° E., and slopes to the North-West regularly under angles of 30° or 40°.* The feld-spar, crystallized in prisms with four unequal sides, and an inch long, passes through all the tints from a flesh red to yellowish white. The mica united in hexagonal plates, is black, and sometimes green. The quartz predominates in the mass; and is generally of a milky white. I observed neither hornblende, nor black schorl, nor rutile titanite, in this granite. In some ledges we recognised round masses, of a blackish gray, very quartzose, and almost destitute of mica. They are from one to two inches diameter; and are found in every zone, in all granitic mountains. These are not imbedded fragments, as at Greiffenstein in Saxony, but aggregations of particles which seem to have been subjected to particular attractions. I could not follow the line of junction of the gneiss and granitic formations. According to angles taken in the valleys of Aragua, the gneiss appears to descend below the granite, which must consequently be of a more recent formation. We shall examine elsewhere the relative antiquity of this rock, when, after our return from the Oroonoko, we shall attempt to trace in a particular chapter the geological table of formations, from the equator to the coast of the Caribbean sea. The appearance of a stratified granite excited my attention the more, because, having had the direction of the mines of Fichtelberg in Franconia for several years, I was accustomed to see granites divided into ledges of three or four feet thick, but little inclined, and forming masses like towers, or old ruins, at the summit of the highest mountains *.

The heat became stifling as we approached

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* At Ochsenkopf, at Rudolphstein, at Epprechtstein, at Luxbourg, and at Schneeberg. The dip of the strata of these granites of Fichtelberg is generally only from 6° to 10°; rarely (at Schneeberg) 18°. According to the dips I observed in the neighbouring strata of gneiss and mica slate, I should think, that the granite of Fichtelberg was very ancient, and serving as a basis for other formations; but the strata of gruenstein, and the disseminated tin-ore, which it contains, may lead us to doubt, from the analogy of the granites of Saxony containing tin, it's great antiquity.

the coast. A reddish vapour veiled the horizon. It was near sunset, and the breeze did not yet blow. We reposed ourselves in the lonely farms known under the names of *Cambury* and *the House of the Canarian (Casa del Islengo)*. The river of hot water, along the banks of which we passed, became deeper and deeper. A crocodile, more than nine feet long, lay dead on the strand. We wished to examine it's teeth, and the inside of it's mouth; but having been exposed to the Sun for several weeks, it exhaled a smell so fetid, that we were obliged to relinquish our design, and remount our horses. When arrived at the level of the sea, the road turns to the East, and crosses a barren shore a league and a half broad, resembling that of Cumana. We there found some scattered cactuses, a sesuvium, a few plants of coccoloba uvifera, and along the coast some avicennias and mangroves. We forded the Guaiguaza, and the Rio Estevan, which by their frequent overflowings form great pools of stagnant water. Small rocks of meandrites, madreporites, and other corals, either ramified or with a rounded surface, rise in this vast plain, like those that threaten the mariner; and seem to attest the recent retreat of the sea. But these masses of the habitations of polypi are only fragments imbedded in a breccia with a calcareous cement. I say a breccia, because we must not confound the fresh and white corallites of this very recent littoral formation, with the corallites blended in the mass of transition rocks, grauwakke, and black limestone. We were astonished to find in this uninhabited spot a large parkinsonia aculeata loaded with flowers. Our botanical works indicate this tree as peculiar to the New World; but during five years we saw it only twice in a wild state, once in the plains of the Rio Guaiguaza, and once in the Llanos of Cumana, thirty leagues from the coast, near la Villa del Pao. Nay, we may even suppose, that this latter place had been an ancient *conuco*, or cultivated enclosure. Every where else on the continent of America we saw the parkinsonia, like the plumeria, only in the gardens of the Indians.

I reached Porto-Cabello in time to take some altitudes of Canopus near the meridian; but these observations, as well as the corresponding altitudes of the Sun, taken on the 28th of February, are not to be entirely depended on *. I did not perceive till too late a slight derangement in the alidade of a sextant by Troughton. It was a snuff-box sextant, of two inches radius, which cannot be too much recommended to the use of travellers. I employed it in general only for geodesical bearings, taken in boats on rivers. At Porto-Cabello, as at La Guayra, it is disputed whether the port lie to the East or to the West of the town, with which the communications are the most frequent. The inhabitants believe, that Porto-Cabello is North-North-West from Nueva Valencia; and indeed my observations give a longitude of three or four minutes more toward the West. Mr. Fidalgo finds a difference toward the East *.

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* *Obs. Ast.*, vol. i, p. 206.

We were received with the utmost kindness in the house of a French physician, Mr. Juliac, who had studied with much advantage, at Montpellier. His small house contained a collection of things the most various, but which were all calculated to interest travellers. We found works of literature and natural history; notes on meteorology; skins of the jaguar and of large aquatic serpents; live animals, monkeys, armadilloes, and birds. Our host was principal surgeon to the royal hospital of Porto-Cabello, and celebrated in the country for his profound study of the yellow fever. During a period of seven years, he had seen six or eight thousand persons enter the hospitals attacked by this cruel malady. He had observed the ravages, that the epidemic caused in Admiral Aristizabal's fleet, in 1793. That fleet lost nearly the third of it's men; for the sailors were almost all unseasoned Europeans, and held an unrestrained

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* See *Introd.* to my *Observ. Ast.*, vol. i, p. xli.

intercourse with the shore. Mr. Juliac had heretofore treated the sick as was commonly practised in Terra Firma, and in the islands, by bleedings, aperient medicines, and acid drinks. In this treatment no attempt was made to raise the vital powers by the action of stimulants. In attempting to calm the fever, the languor and debility were augmented. In the hospitals, where the sick were crowded, the mortality was then thirty-three in a hundred among the white Creoles; and sixty-five in a hundred, among the Europeans recently disembarked. Since a stimulant treatment, the use of opium, of benzoin, and of alcoholic draughts, has been substituted for the ancient debilitating method, the mortality has considerably diminished. It was believed to be reduced to twenty in a hundred among Europeans, and ten among Creoles *; even when black vomitings, and haemorrhages from the nose, ears, and gums, in-

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* I have treated in another work of the proportions of mortality in the yellow fever. *Nouv. Esp.*, vol. ii, p. 777—785, and 867. At Cadiz, the *average* mortality was, in 1800, twenty in a hundred; at Seville, in 1801, it amounted to sixty in a hundred. At Vera-Cruz the mortality does not exceed twelve or fifteen in a hundred, when the sick can be properly attended. In the civil hospitals of Paris, the number of deaths, one year with another, is from fourteen to eighteen in a hundred; bnt it is asserted, that a great number of patients enter the hospitals almost dying, or at a very advanced time of life.

dicated a high degree of *exacerbation* in the malady. I relate faithfully what was then given as the general result of observation: but I think, in these numerical comparisons, it must not be forgotten, that, notwithstanding appearances, the epidemics of several successive years do not resemble each other; and that, in order to decide on the use of fortifying or debilitating remedies, (if indeed this difference exist in an absolute sense,) we must distinguish between the various periods of the malady.

The climate of Porto-Cabello is less ardent than that of La Guayra. The breeze there is stronger, more frequent, and more regular. The houses do not lean against rocks, that absorb the rays of the Sun during the day, and emit caloric at night. The air can circulate more freely between the coast and the mountains of Ilaria. The causes of the insalubrity of the atmosphere must be sought in the shores that extend to the East, as far as the eye can reach, toward the *Punta de Tucacos,* near the fine port of Chichiribiche. There are the salt-works; and there at the beginning of the rainy season tertian fevers prevail, and easily degenerate into asthenic fevers. A curious observation has been made, that the Mestizoes who are employed in the salt-works are more tawny, and have a yellower skin, when they have suffered several successive years from those fevers, which are called the *malady of the coast*. The poor fishermen, who dwell on this shore, assert, that it is not the inundations of the sea, and the retreat of the salt-water, which render the lands covered with mangroves so unhealthful*; but that the insalubrity of the air is owing to the fresh water, to the overflowings of the Guayguaza and Estevan, the swell of which is so great and sudden in the months of October and November. The banks of the Rio Estevan have been less dangerous to inhabit, since little plantations of maizè and plantains have been established; and, by raising and hardening the ground, the river has been contained within narrower limits. A plan is formed of giving another issue to the Rio San Estevan, and thus to render the environs of Porto-Cabello more wholesome. A canal is to lead the waters toward that part of the coast, which is opposite the island of Guaiguaza.

The salt-works of Porto-Cabello somewhat resemble those of the peninsula of Araya, near Cumana. The earth, however, which they lixiviate by collecting the pluvial waters into small basins, contains less salt. It is questioned here, as at Cumana, whether the ground be impregnated with saline particles, because it has been for ages covered at intervals with sea-water, evaporated by the heat of the Sun; or whether the soil be muriatiferous, as in a mine very poor in native salt. I had not leisure to examine this plain with the same attention as the peninsula of Araya. Besides, does not this problem reduce itself to the simple question, whether the salt be owing to new or very ancient inundations? The labouring at the salt-works of Porto-Cabello being extremely unhealthy, the poorest men alone employ themselves in it. They collect the salt in little stores, and afterward sell it to the shopkeepers in the town.

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* In the West India islands, all the dreadful maladies, which prevail during the wintery season, have been for a long time attributed to the South winds. These winds convey the emanations of the mouths of the Oroonoko, and of the small rivers of Terra Firma, toward the high latitudes.

During our abode at Porto-Cabello, the current on the coast, generally[*] directed toward the West, ran from West to East. *This current upward (corriente por arriba)*, which we have already mentioned, is very frequent during two or three months of the year, from September to November. It is believed to be owing to some North-West winds, that have blown between Jamaica and Cape St. Antony in the island of Cuba.

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[*] The wrecks of the Spanish ships, burnt at the island of Trinidad, at the time of it's occupation by the English, in 1797, were carried by the *general* or *rotary current* to Punta Brava, near Porto-Cabello. This general current toward the East, from the coasts of Paria to the isthmus of Panama and the western extremity of the island of Cuba, was the subject of a violent dispute between Don Diego Columbus, Oviedo, and the pilot Andres, in the sixteenth century. See "De novis opinionibus fluentis ad occidentem pelagi Pariensis; et de impulsu cælorum, quo torrentes exeunt ad occidentem, et per universum circumaguntur." *Pet. Mart. Ocean., Dec. ii, lib. x*, p. 227.

The military defence of the coasts of Terra Firma rests on six points. The castle of St. Antony, at Cumana; the Morro de Nueva Barcelona; the fortifications of La Guayra, mounting one hundred and thirty-four guns; Porto-Cabello; fort St. Charles, at the mouth of the lake of Maracaybo; and Carthagena. Porto-Cabello is, next to Carthagena, the most important fortified place. The town is quite modern, and the port is one of the finest known in both worlds. Art has had scarcely any thing to add to the advantages, which the nature of the spot presents. A neck of land stretches first toward the North, and then toward the West. It's western extremity is opposite to a range of islands, connected by bridges, and so close together, that they might be taken for another neck of land. These islands are all composed of a calcareous breccia, of extremely recent formation, and analogous to that we have described on the coasts of Cumana, and near the castle of Araya. It is an agglomerate, containing fragments of madrepores and other corals cemented by a limestone basis and grains of sand. We had already seen this agglomerate near the Rio Guayguaza. By the singular disposition of the ground the port resembles a basin, or a little inland lake, the southern extremity of which is filled with little islands, covered with mangroves. The opening of the port toward the West contributes much to the smoothness of the water *. One vessel only can enter at a time; but the largest ships of the line can anchor very near land, to take in water. There is no other danger in entering the harbour, than the reefs of Punta Brava, opposite which a battery of eight guns has been erected. Toward the West and South-West we see the fort, which is a regular pentagon with five bastions, the battery of the reef, and the fortifications that surround the ancient town, founded on an island of a trapezoidal form. A bridge, and the fortified gate of the *Staccado*, join the old to the new town, which is already larger, though considered only as a suburb. The bottom of the basin or little lake, which forms the harbour of Porto-Cabello, turns behind this suburb to the South-West. It is a marshy ground, filled with noisome and stagnant water. The town, which has at present nearly nine thousand inhabitants, owes it's origin to an illicit commerce, attracted to these shores by the proximity of the town of Burburata, which was founded in 1549. It is only under the administration of the Biscayans, and of the company of Guipuzcoa, that Porto-Cabello, which was but a hamlet, has been converted into a well fortified town. The vessels of La Guayra, which is less a port than a bad open roadstead, come to Porto-Cabello to be caulked and repaired.

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* It is disputed at Porto-Cabello, whether the name of the Port be owing to the tranquillity of it's waters, "which would not move a hair *(cabello)*;" or, which is more probable, derived from Antonio Cabello, one of the fishermen, with whom the smugglers of Curassoa had formed an intimate connection, at the period when the first hamlet was constructed on this half-desert coast.

The real defence of the harbour consists in the low batteries of the neck of land at Punta Brava, and of the reef: but from ignorance of this principle, a new fort, the Belvidere *(Mirador)* of Solano * has been constructed at a great expense, on the mountains that command the suburb toward the South. This work, a quarter of a league distant from the harbour, is raised four or five hundred feet above the surface of the water. The construction has cost annually, during a great number of years, from twenty to thirty thousand piastres. The captain-general of Caraccas, Mr. de Guevara Vasconzelos, was of opinion with the most able Spanish engineers, that the *Mirador*, which in my time mounted only sixteen guns, would contribute very little to the defence of the place, and caused the work to be suspended. Long experience has proved, that very elevated batteries, even when provided with heavy guns, act with much less effect in defending a roadstead, than low and half-drowned batteries, mounted with cannon of less size, but erected on the shore itself or on jetties. We found Porto-Cabello in a state of defence little calculated to inspire confidence. The fortifications of the port and round the town, which have about sixty guns, require a garrison of eighteen hundred or two thousand men, and there were not six hundred. One of the king's frigates had been attacked in the night by the armed boats of an English man-of-war, and taken, though anchored at the entrance of the harbour. The blockade rather favoured than prevented illicit commerce; and every thing at Porto-Cabello seemed to announce the increase of population and industry. Among the most active branches of fraudulent intercourse are those with the islands of Curassoa and Jamaica. More than ten thousand mules are exported annually. It is curious enough to see these animals embarked; they are thrown down with ropes, and then hoisted on board the vessels by means of a machine resembling a crane. Ranged in two files, the mules with difficulty keep their feet during the rolling and pitching of the ship; and in order to frighten and render them more docile, the drum is beaten during a great part of the day and night. We may guess what quiet a passenger enjoys, who has the courage to embark for Jamaica in a schooner laden with mules.

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* The mirador is placed to the East of the *Vigia altu*, and to the South-East of the battery of the salt-works, and the powder-mill.

We left Porto-Cabello on the 1st of March at sunrise. We saw with surprise the great number of boats, that were laden with fruit to be sold at the market. It reminded me of a fine morning at Venice. The town presents in general, on the side toward the sea, a cheerful and agreeable aspect. Mountains covered with vegetation, and crowned with peaks*, which from their outline would be taken for rocks of trap, form the back ground of the landscape. Near the coast, all is bare, white, and strongly illumined, while the screen of mountains is clothed with trees of thick foliage, that project their vast shadows upon the brown and rocky ground. On going out of the town we visited an aqueduct, that had been just finished. It is five thousand *varas* long, and conveys the waters of the Rio Estevan by a trench to the town. This work has cost more than thirty thousand piastres; but it's waters gush out in every street.

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* *Las Tetas de Ilaria.*

We returned from Porto-Cabello to the valleys of Aragua, and again stopped at the plantation of Barbula, by which the new road to Valencia is traced. We had heard several weeks before of a tree, the juice of which is a nourishing milk. It is called *the cow-tree;* and we were assured, that the Negroes of the farm, who drink plentifully of this vegetable milk, consider it as a wholesome aliment. All the milky juices of plants being acrid, bitter, and more or less poisonous, this assertion appeared to us very extraordinary; but we found by experience during our stay at Barbula, that the virtues of the *palo de vaca* had not been exaggerated. This fine tree rises like the broad-leaved star-apple *. It's oblong and pointed leaves, tough and alternate, are marked by lateral ribs, prominent at the lower surface, and parallel. They are some of them ten inches long. We did not see the flower: the fruit is somewhat fleshy, and contains one or sometimes two nuts. When incisions are made in the trunk of the *cow-tree,* it yields abundance of a glutinous milk, tolerably thick, destitute of all acrimony, and of an agreeable and balmy smell. It was offered to us in the shell of the *tutumo* or calebash-tree. We drank considerable quantities of it in the evening before we went to bed, and very early in the morning, without feeling the least injurious effect. The viscosity of this milk alone renders it a little disagreeable. The Negroes and the free people, who work in the plantations, drink it, dipping into it their bread of maize or cassava. The majordomo of the farm told us, that the Negroes grow sensibly fatter during the season, when the *palo de vaca* furnishes them with most milk. This juice, exposed to the air, presents at it's surface, perhaps in consequence of the absorption of the atmospheric oxygen, membranes of a strongly animalized substance, yellowish, stringy, and resembling a cheesy substance. These membranes, separated from the rest of the more aqueous liquid, are elastic, almost like caoutchouc; but they undergo in time the same phenomena of putrefaction as *gelatine*. The people call the coagulum, that separates by the contact of the air, cheese. This coagulum grows sour in the space of five or six days, as I observed in the small portions which I carried to Nueva Valencia. The milk, contained in a stopped vial, had deposited a little *coagulum;* and, far from becoming fetid, it exhaled constantly a balsamic odour. The fresh juice, mixed with cold water, was scarcely coagulated at all; but on the contact of nitric acid the separation of the viscous membranes took place. We sent two bottles of this milk to Mr. Fourcroy at Paris: in one it was in it's natural state, and in the other mixed with a certain quantity of carbónat of soda. The French consul residing in the island of St. Thomas undertook to convey them to him.

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* Chrysophyllum cainito. See *Annales du Musée,* vol. ii, p. 180.

The extraordinary tree, of which we have been speaking, appears to be peculiar to the *Cordillera of the coast*, particularly from Barbula to the lake of Maracaybo. Some stocks of it exist near the village of San Mateo; and, according to Mr. Bredemeyer, whose travels have so much enriched the fine hot-houses of Schoenbrunn and Vienna, in the valley of Caucagua, three days journey East of Caraccas. This naturalist found, like us, that the vegetable milk of the *palo de vaca* had an agreeable taste, and an aromatic smell. At Caucagua, the natives call the tree, that furnishes this nourishing juice, *the milk-tree (arbol de leche)*. They profess to recognize, from the thickness and colour of the foliage, the trunks that yield the most juice; as the herdsman distinguishes, from external signs, a good milch-cow. No botanist has hitherto known the existence of this plant, of which it is easy to procure the parts of fructification. It seems, according to Mr. Kunth, to belong to the sapota family*. Long after my return to Europe, I found in the Description of the East Indies by Laet, a Dutchman, a passage, that seems to have some relation to the cow-tree. "There exist trees," says Laet†, "in the province of Cumana, the sap of which resembles curdled milk, and affords a *salubrious nourishment.*"

Amid the great number of curious phenomena, which have presented themselves to me in the course of my travels, I confess there are few, that have so powerfully affected my imagination as the aspect of the cow-tree. Whatever relates to milk, whatever regards corn, inspires an interest, which is not merely that of the physical knowledge of things, but is connected with another order of ideas and sentiments. We can scarcely conceive how the human race could exist without farinaceous substances; and without that nourishing juice, which the breast of the mother contains, and which is appropriated to the long feebleness of the infant. The amylaceous matter of corn, the object of religious veneration among so many nations, ancient and modern, is diffused in the seeds, and deposited in the roots of vegetables; milk, which serves us as an aliment, appears to us exclusively the produce of animal organization. Such are the impressions we have received in our earliest infancy: such is also the source of that astonishment, which seizes us at the aspect of the tree just described. It is not here the solemn shades of forests, the majestic course of rivers, the mountains wrapped in eternal frost, that excite our emotion. A few drops of vegetable juice recall to our minds all the powerfulness and the fecundity of nature. On the barren flank of a rock grows a tree with coriaceous and dry leaves. It's large woody roots can scarcely penetrate into the stone. For several months of the year not a single shower moistens it's foliage. It's branches appear dead and dried; but when the trunk is pierced, there flows from it a sweet and nourishing milk. It is at the rising of the Sun, that this vegetable fountain is most abundant. The Blacks and natives are then seen hastening from all quarters, furnished with large bowls to receive the milk, which grows yellow, and thickens at it's surface. Some employ their bowls under the tree itself, others carry the juice home to their children. We seem to see the family of a shepherd, who distributes the milk of his flock.

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* *Galactodendrum*, ex familia sapotearum. Arbor 6-7—orgyalis. *Ramuli* teretes; glabri, juniores angulati, tenuissime canescenti-puberuli. *Gemmæ* terminales, subulatæ, convolutæ, sericeo-pubescentes. *Folia* alterna, petiolata, oblonga, utrinque rotundata, apice brevissime acuminata, integerrima, reticulato-venosa, venis primariis transversalibus paulo approximatis subparallelis nervoque subtus prominentibus, subcoriacea, glaberrima, exsiccata supra viridia, subtus aureo-fusca, novem aut decem pollices longa, vix quatuor pollices lata. *Petioli* crassi, canaliculati, glabri, 8 aut 9 lineas longi. *Stipulæ* nullæ. *Fructus* facie drupæ juglandis, carnosus, globosus, viridis, foetus nucibus 1 aut 2, monospermis (Drupa? pluri—, arbotu uni-aut bilocularis: loculis monospermis?) *Kunth* in *Humb. et Bonpl., Nov. Gen.*, Tom. iii, ined.

† Inter arbores quæ sponte hic passim nascuntur, memorantur a scriptoribus hispanis quædam quæ lacteum quemdam liquorem fundunt, qui durus admodum evadit instar gummi et suavem odorem de se fundit; aliæ quæ *liquorem quemdam edunt, instar lactis coagulati, qui in cibis ab ipsis usurpatur sine noxa. Descript. Ind. occ., Lib.* 18, *Cap.* 4 (ed. 1633, p. 672).

I have described the sensations, which *the cow-tree* awakens in the mind of the traveller at the first view. In examining the physical properties of animal and vegetable products, science displays them as closely linked together; but it strips them of what is marvellous, and perhaps also of a part of their charms, of what excited our astonishment. Nothing appears isolated; the chemical principles, that were believed to be peculiar to animals, are found in plants; a common chain links together all organic nature.

Long before chemists had recognized small portions of wax in the pollen of flowers, the varnish of leaves, and the whitish dust of our plums and grapes, the inhabitants of the Andes of Quindiu fabricated tapers with the thick layer of wax, that covers the trunk of a palm-tree[*]. It is but a few years since we have discovered in Europe *caseum*, the basis of cheese, in the emulsion of almonds[†]; yet for ages past in the mountains of the coast of Venezuela the milk of a tree, and the cheese separated from that vegetable milk, have been considered as a salutary aliment. What is the cause of this singular course in the unfolding of our knowledge? How have the vulgar in one hemisphere recognized, what in the other has so long escaped the sagacity of chemists, accustomed to interrogate nature, and seize her in her mysterious progress? It is that a small number of elements and principles differently combined are spread through several families of plants; it is that the genera and species of these natural families are not equally distributed in the torrid, the frigid, and the temperate zones; it is that tribes excited by want, and deriving almost all their subsistence from the vegetable kingdom, discover nourishing principles, farinaceous and alimentary substances, wherever nature has deposited them in the sap, the bark, the roots, or the fruits of vegetables.

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[*] *Ceroxylon andicola*, which we have described in our Plantes Equinoxiales, vol. i, p. 9, Pl. i and ii.

[†] Proust in the Journ. de Physique, vol. liv, p. 430. Boullay and Vogel, in the Annales de Chimie et de Physique, vol. vi, p. 408.

That amylaceous fecula, which the seeds of the cereal plants furnish in all it's purity, is found united with an acrid, and sometimes even poisonous juice, in the roots of the arums, the tacca pinnatifida, and the iatropha manihot. The savage of America, like the savage of the islands in the Pacific Ocean, has learned to *dulcify* the fecula, by pressing and separating it from it's juice. In the milk of plants, and in the milky emulsions, matter extremely nourishing, albumen, *caseum,* and sugar, are found mixed with caoutchouc and with deleterious and caustic principles, such as *morphin* and the hydrocyanic acid*. These mixtures vary not only in the different families, but also in the species which belong to the same genus. Sometimes it is the *morphin,* or narcotic principle, that characterizes the vegetable milk, as in some papaverous plants; sometimes it is caoutchouc, as in the hevea, and the castilloa; sometimes albumen and *caseum,* as in the *cow-tree.*

The lactescent plants belong chiefly to the three families of the euphorbiaceæ, the urticeæ, and the apocineæ †; and since, on examining the distribution of vegetable forms over the globe, we find that those three families are more numerous in species in the low regions of the tropics, we must thence conclude, that a very elevated temperature contributes to the elaboration of the milky juices, to the formation of caoutchouc, albumen, and caseous matter. The sap of the *palo de vaca* furnishes unquestionably the most striking example of a vegetable milk, in which the acrid and deleterious principle is not united with the albumen, the *caseum,* and the caoutchouc: the genera euphorbia and asclepias, however, though generally known for their caustic properties, had already presented us with a few species, the juice of which is sweet and harmless. Such are the *tabayba dulce* of the Canary islands, which we have already mentioned *, and the *asclepias lactifera* of Ceylon. Burman relates, that in the latter country, when cow's milk is wanting, the milk of this asclepias is used; and that the aliments commonly prepared with animal milk are boiled with it's leaves. We may hope, that a traveller, deeply versed in chemical knowledge, Dr. John Davy, will throw

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* Opium contains *morphin,* caoutchouc, &c.

† After these three great families follow the papaveraceæ, the chicoraceæ, the lobeliaceæ, the campanulaceæ, the sapotas, and the cucurbitaceæ. The hydrocyanic acid is peculiar to the group of rosaceo-amygdalaceæ. In the monocotyledonous plants there is no milky juice; but the perisperm of the

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palms, which yields such sweet and agreeable milky emulsions, contains no doubt *caseum.* Of what nature is the milk of mushrooms?

* Euphorbia balsamifera. See above, p. 180. The milky juice of the cactus mamillaris is equally sweet. (*De Candolle, Essai sur les Propr. méd. des Plantes,* p. 156.)

light on this fact during his stay at the island of Ceylon; for it may be possible, as Mr. Decandolle has well observed, that the natives employ only the juice that flows from the young plant, at a period when the acrid principle is not yet developed. In fact, the first shoots of the apocyneous plants are eaten in several countries*.

I have endeavoured, by these comparisons, to bring into consideration under a more general point of view the milky juices, that circulate in vegetables; and the milky emulsions, that the fruits of the amygdalaceous plants and palms yield. I may be permitted to add the result of some experiments, which I attempted to make on the juice of the carica papaya during my stay in the valleys of Aragua, though I was then almost destitute of chemical tests. The juice has been since examined by Mr. Vauquelin †. This celebrated chemist has very clearly recognized the albumen and caseous matter; he compares the milky sap to a substance strongly animalized, to the blood of animals; but his researches were confined to a fermented juice, and a *coagulum* of a fetid smell formed during the passage from the Isle of France to Havre. He has expressed a wish, that some traveller would examine the milk of the papaw-tree just as it flows from the stem or the fruit.

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* Ib. p. 215.

† Vauquelin and Cadet de Gassicourt, in the *Annales de Chimie*, vol. xliii, p. 275; xlix, p. 250 and 304.

The younger the fruit of the carica, the more milk it yields; it is found already in the germen scarcely fecundated. In proportion as the fruit ripens, the milk, less abundant, becomes more aqueous. Less of that animal matter, which is *coagulable* by acids and by the absorption of atmospheric oxygen, is found in it. As the whole fruit is viscous *, it might be supposed, that, as it grows larger, the *coagulable* matter is deposed in the organs, and forms a part of the pulp, or the fleshy substance. When nitric acid, diluted with four parts of water, is added drop by drop to the milk expressed from a very young fruit, a very extraordinary phenomenon appears. At the centre of each drop a gelatinous pellicle is formed, divided by grayish streaks. These streaks are simply the juice rendered more aqueous, owing to the contact of the acid having deprived it of the albumen. At the same time, the centre of the pellicles becomes opaque, and of the colour of the yolk of an egg; they enlarge as if by the prolongation of divergent fibres. The whole liquid assumes at first the appearance of an agate with milky clouds; and it seems as if organic membranes were forming under the eye of the observer. When the *coagulum* extends to the whole mass, the yellow spots again disappear. By agitation it becomes granulous like soft cheese*. The yellow colour reappears on adding afresh a few drops of nitric acid. The acid acts in this instance as the oxygen of the atmosphere at a temperature from 27° to 35°; for the white coagulum grows yellow in two or three minutes, when exposed to the Sun. After a few hours the yellow colour turns to brown, no doubt because the carbon is set more free progressively as the hydrogen, with which it was combined, is burnt. The *coagulum* formed by the acid becomes viscous, and acquires that smell of wax, which I have observed in treating muscular flesh and mushrooms *(morels)* with nitric acid*. According to the fine experiments of Mr. Hatchett, the albumen may be supposed to pass partly to the state of gelatine. The *coagulum* of the papaw-tree, when newly prepared, being thrown into water, softens, dissolves in part, and gives a yellowish tint to the fluid. The milk, placed in contact with water only, forms also membranes. In an instant a tremulous jelly is precipitated, resembling starch. This phenomenon is particularly striking, if the water employed be heated to 40° or 60°. The jelly condenses in proportion as more water is poured upon it. It preserves a long time it's whiteness, only growing yellow by the contact of a few drops of nitric acid. Guided by the experiments of Messrs. Fourcroy and Vauquelin on the juice of the hevea, I mixed a solution of carbonat of soda with the milk of the papaw. No clot is formed, even when pure water is poured on a mixture of the milk with the alkaline solution. The membranes appear only when, by adding an acid, the soda is neutralized, and the acid is in excess. I made the *coagúlum* formed by nitric acid, the juice of lemons, or hot water, equally disappear by mixing it with carbonat of soda. The sap becomes milky and liquid afresh, as in it's primitive state; but this experiment succeeds only when the coagulum has been recently formed.

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* It is the same viscosity, which is remarked also in the fresh milk of the *palo de vaca*. It is no doubt occasioned by the caoutchouc, which is not yet separated, and which forms one mass with the albumen and the *caseum*, as the butter and the *caseum* in animal milk. The juice of a euphorbiaceous plant, the sapium aucaparium, which also yields caoutchouc, is so glutinous, that it is used to catch parrots. (*De Candolle, loco cit.*, p. 263.)

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* The substance which falls down in grumes and filamentous clods is not pure caoutchouc, but perhaps a mixture of this substance with *caseum* and albumen. Acids precipitate the caoutchouc from the milky juice of the euphorbiums, fig-trees, and hevea; they precipitate the *caseum* from the milk of animals. A white *coagulum* was formed in vials *closely* stopped, containing the milk of the hevea, and preserved among our collections, during our journey to the Oroonoko. It is perhaps the developement of a vegetable acid, that then furnishes oxygen to the albumen. The formation of the coagulum of the hevea, or of a real caoutchouc, is nevertheless much more rapid in contact with the air. The absorption of atmospheric oxygen is not in the least necessary to the production of butter, which exists already formed in the milk of animals; but I believe it cannot be doubted, that, in the milk of plants, this absorption produces the pellicles of caoutchouc, of coagulated albumen, and of *caseum*, which are successively formed in vessels exposed to the open air.

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* See my Experiments on the Irritable and Nervous Fibre, (in German,) vol. i, p. 177.

In comparing the milky juices of the papaw, the *cow-tree*, and the hevea, there appears a striking analogy between the juices which abound in caseous matter, and those in which the caoutchouc prevails. All the white and newly prepared caoutchouc, as well as the *impermeable cloaks*, manufactured in Spanish America by placing a layer of milk of hevea between two pieces of cloth; exhale an animal and nauseating smell. This seems to indicate, that the caoutchouc, in coagulating, carries with it the *caseum*, which is perhaps only an altered albumen *.

The produce of the bread fruit tree can no more be considered as bread, than the plantains before the state of maturity, or the tuberous and amylaceous roots of the cassava, the dioscorea, the convolvulus batatas, and the potato. The milk of the *cow-tree* contains, on the contrary, the caseous matter, like the milk of mammiferous animals. Raising our minds to more general considerations, we shall regard, with Mr. Gay-Lussac, the caoutchouc as the oily part, the butter of vegetable milk. We find in the milk of plants *caseum* and *caoutchouc*; in the milk of animals, *caseum* and *butter*. The proportions of the two albuminous and oily principles differ in the various species of animals and of lactescent plants. In these last they are most frequently mixed with other substances hurtful as food; but of which the separation might perhaps be obtained by chemical processes. A vegetable milk becomes nourishing, when it is destitute of acrid and narcotic principles; and abounds less in caoutchouc, than in caseous matter.

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* See note B, at the end of this book.

If the palo de vaca display to us the immense fecundity and the bounty of nature under the torrid zone, it reminds us also of the numerous causes, which favour in those fine climates the careless indolence of man. Mungo Park has made known to us the *butter-tree* of Bambarra, which Mr. de Candolle suspects to be of the family of the sapotas, as well as our *milk-tree*. The plantains, the sago-tree, the mauritias of the Oroonoko, are as much *bread-trees* as the rema of the South Sea. The fruits of the crescentia and the lecythis serve for vessels: the spathes of the palms, and the bark of trees, furnish caps and garments without a seam. The knots, or rather the interior cells of the trunks of bamboos, supply ladders; and facilitate in a thousand ways the construction of a hut, and the fabrication of chairs, beds, and other articles of furniture, that compose the wealth of a savage. In the midst of this lavish vegetation, so varied in it's productions, it requires very powerful motives, to excite men to labour, to awaken him from his lethargy, and unfold his intellectual faculties.

The cacao-tree and cotton are cultivated at Barbula. We there found, what is very rare in that country, two large cylindrical machines for separating cotton from it's seeds; one put in motion by an hydraulic wheel, and the other by a wheel turned by mules. The majordomo of the farm, who had constructed these machines, was a native of Merida. He was acquainted with the road, that leads from Nueva Valencia, by Guanare and Misagual, to Varinas; and thence, by the ravine of Callejones, to the Paramo de Mucuchies and the mountains of Merida covered with eternal snows. The notions he gave us of the time requisite for going from Valencia by Varinas to the *Sierra Nevada*, and thence by the port of Torunos, and the Rio Santo Domingo, to San Fernando de Apure, were of infinite value to us. It can scarcely be imagined in Europe, how difficult it is to obtain accurate information, in a country where the communications are so rare; and where the length of distances is diminished, or exaggerated, according to the desire that is felt of encouraging the traveller, or averting him from his purpose. On leaving Caraccas, I had placed money in the hands of the intendant of the province, to be paid by the officers of the Royal Treasury at Varinas. I had resolved to visit the eastern extremity of the Cordilleras of New Grenada, where they lose themselves in the paramos of Timotes and Niquitao. I learned at Barbula, that this excursion would retard our arrival at the Oroonoko thirty-five days. This delay appeared to us so much the longer, as the rains were expected to begin sooner than usual. We had the hope of examining afterward a great number of mountains covered with perpetual snow, at Quito, Peru, and Mexico; and it appeared to me still more prudent, to relinquish our project of visiting the mountains of Merida, on account of the apprehension, that by so doing we might miss the real object of our journey, that of ascertaining by astronomical observations the point of communication between the Oroonoko and the Rio Negro and the river of Amazons. We returned in consequence from Barbula to Guacara, to take leave of the respectable family of the Marquis del Toro, and pass three days more on the borders of the lake.

It was the time of carnival, and all was gaiety.

The sports in which the people indulge themselves, and which are called games of *carnes tollendas*, assume sometimes a little of a savage character. Some led an ass loaded with water, and, wherever they found a window open, sprinkled the apartment within by means of a pump. Others carry bags filled with the hairs of *picapica*, or dolichos pruriens; and blow the hair, which causes a great irritation of the skin, into the faces of those who pass by.

From Guacara we returned to Nueva Valencia*. We found there a few French emigrants, the only ones we saw during five years passed in the Spanish colonies. Notwithstanding the ties of blood, that unite the royal families of France and Spain, even French priests were not permitted to take refuge in that part of the New World, where man with such facility finds food and shelter. Beyond the ocean, the United States of America afforded the only asylum to misfortune. A government, strong because it is free, confiding because it is just, had nothing to fear in giving refuge to the proscribed.

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* I found the latitude of the Hacienda de Cura, one of the best determined points, 10° 15′ 40″; that of Guacara, 10° 11′ 23″; that of Nueva Valencia, 10° 9′ 56″, (*Obs. Ast.*, vol. i, p. 199—204, and 207—209. The variation of the needle, at the Hacienda de Cura, on the 17th of February, 1800, was 4° 48′ 50″ N. E. The magnetic dip amounted, at Hacienda de Cura, to 41·20°; at Nueva Valencia, to 41·75°. In these two places, the oscillations in ten minutes time were two hundred and thirty and two hundred and twenty-four. All these observations were made in the open air, far from any edifice. See above, chap. xv, p. 108

We have endeavoured above, to give some precise notions of the state of the cultivation of indigo, cotton, and sugar, in the province of Caraccas. Before we quit the valley of Aragua and it's neighbouring coast, it remains for us to speak of the cacao-plantations, which have at all times been considered as the principal source of the prosperity of those countries. The province of Caraccas *, at the end of the eighteenth century, produced annually a hundred and fifty thousand *fanegas*, of which a hundred thousand were consumed in Spain, and thirty thousand in the province. Estimating a *fanega* of cacao at only twenty-five piastres for the price given at Cadiz, we find, that the total value of the exportation of cacao, by the six ports of the

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* The province, not the Capitania General, consequently excluding the cacao-plantations of Cumana, of the province of Barcelona, of Maracaybo, of Varinas, and of Spanish Guyana. During the war, the price of a *fanega* was, in 1800, in the province of Caraccas, twelve piastres, and in Spain, seventy piastres. From 1781 to 1799, the prices of a *fanega* varied at Cadiz from forty to a hundred piastres. The expense of freight from La Guayra to Cadiz amounts in time of peace to three piastres, and in time of war to eleven or twelve piastres a *fanega*. In time of peace the price of cacao is from twelve to twenty piastres the *fanega* at Caraccas.

Capitania General of Caraccas*, amounts to four million eight hundred thousand piastres. So important an object of commerce merits a careful discussion; and I flatter myself, that, from the great number of materials I have collected on all the branches of colonial agriculture, I shall be able to add something to the information published by Mr. Depons, in his valuable work on the provinces of Venezuela.

The tree that produces the cacao is not at present found wild in the forests of Terra Firma to the North of the Oroonoko; we began to find it only beyond the cataracts of Atures and Maypures. It abounds particularly near the banks of the Ventuari, and on the Upper Oroonoko, between the Padamo and the Gehette. This scarcity of wild cacao-trees in South America, North of the latitude of 6°, is a very curious phenomenon of botanical geography, and yet little known. This phenomenon appears so much the more surprising, as, according to the annual produce of the harvest, the number of trees in full bearing in the cacao-plantations of Caraccas, Nueva Barcelona, Venézuela, Varinas, and Maracaybo, is estimated at more than sixteen millions. The wild cacao-tree has many branches, and is covered with a tufted and dark foliage. It bears a very small fruit, like that variety which the ancient Mexicans called *tlalcacahuatl.* Transplanted into the *conucos* of the Indians of Cassiquiare and the Rio Negro, the wild tree preserves for several generations that force of vegetable life, which makes it bear fruit in the fourth year; while in the province of Caraccas, the harvest begins only the sixth, seventh, or eighth year. They are later in the inland parts, than on the coasts and in the valley of Guapo. We met with no tribe on the Oroonoko, that prepared a beverage with the seeds of the cacao-tree. The savages suck the pulp of the pod, and throw away the seeds, which are often found in heaps where they have passed the night. Though the *chorote,* which is a very weak infusion of cacao, is considered on the coast to be a very ancient beverage, no historical fact proves, that chocolate, or any preparation whatever of cacao, was known to the natives of Venezuela before the arrival of the Spaniards. It appears to me more probable, that the cacao-plantations of Caraccas were made in imitation of those of Mexico and Guatimala; and that the Spaniards, inhabiting Terra Firma, learned the cultivation of the cacao-tree, sheltered in it's youth by the foliage of the erythrina and plantain [*]; the fabrication of cakes of *chocolatl*, and the use of the liquid of the same name, by their communications with Mexico, Guatimala, and Nicaragua, three countries; the inhabitants of which were of Tolteck and Azteck origin.

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* St. Thomas in New Guyana, or Angostura, Cumana, Nueva Barcelona, La Guayra, Porto-Cabello, and Maracaybo.

Up to the sixteenth century, travellers differ in the opinions they give respecting *chocolatl*. Benzoni, in his ingenuous style, says, that it is a drink rather *da porci, che da huomine*, "fitter for hogs than men [†]." The Jesuit Acosta [‡] asserts, that "the Spaniards, who inhabit America, are fond of chocolate to excess; but that it requires to be accustomed to that black beverage, not to be sick at the mere sight of it's froth, which swims on it like yeast on a fermented liquor." He adds: "the cacao is a prejudice *(una supersticion)* of the Mexicans, as the coca is a prejudice of the Peruvians." These opinions remind us of Madame de Sevigne's prediction respecting the use of coffee. Ferdinand Cortez, and his page, the *gentil-*

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[*] This process of the Mexican cultivators, exactly practised on the coast of Caraccas, is already described in the memoirs known under the title of *Relazione di certo Gentiluomo del Signor Cortez, Conquistadore del Messico.* (*Ramusio*, tom. ii, p. 134.)

[†] *Girolamo Benzoni, Milanese, Hist. del Mondo Nuovo*, 1572, p. 104.

[‡] *Hist. Nat. de Indias, Lib. iv, c.* 22 (edit. de 1589), p. 251.

hombre del gran Conquistador, whose memoirs were published by Ramusio, on the contrary, highly praise chocolate, not only as an agreeable drink, though prepared cold *, but in particular as a nutritious substance. "He who has drunk one cup," says the page of Ferdinand Cortez, "can travel a whole day without any other food, especially in very hot climates; for *chocolate is by it's nature cold and refreshing*." We shall not subscribe to the latter part of this assertion; but we shall soon have occasion, in our voyage on the Oroonoko, and our excursions toward the summit of the Cordilleras, to celebrate the salutary properties of chocolate. Alike easy to convey, and employ as an aliment, it contains a large quantity of nutritive and stimulating particles in a small compass. It has been said with truth, that in Africa, rice, gum, and *shea* butter, assist man in crossing the deserts. In the New World, chocolate and the flower of maize have rendered accessible to him the table-lands of the Andes, and vast uninhabited forests.

The cacao-harvest is extremely variable. The tree vegetates with such strength, that flowers spring out even from the ligneous roots, wherever the earth leaves them uncovered. It suffers from the North-East winds, even when these winds lower the temperature only a few degrees. The heavy showers, that fall irregularly after the rainy season during the winter months, from December to March, are also very hurtful to the cacao-tree. The propriictor of a plantation of fifty thousand trees often loses the value of more than four or five thousand piastres in cacao in one hour. Great humidity is favorable to the tree only when it augments progressively, and is for a long time uninterrupted. If, in the season of drought, the leaves and the young fruit be wetted by a violent shower, the fruit falls from the stem. It appears, that the vessels, which absorb water, break from being rendered turgid. But if the cacao harvest be one of the most uncertain, on account of the fatal effects of intemperate seasons, and the great number of worms, insects, birds, and quadrupeds *, that devour the pod of the cacao-tree; if this branch of agriculture have the disadvantage of obliging the new planter to wait eight or ten years for the fruit of his labours, and of yielding an article of very difficult pre-

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* Father Gili has very clearly shown, from two passages in Torquemado (*Monarquia Indiana*, lib. xiv, cap. 14 et 42), that the Mexicans prepared the infusion *cold;* and that the Spaniards have introduced the custom of preparing chocolate by boiling water with the paste of cacao.

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* The parrots, monkeys, agoutis, squirrels, and stags. (See Depons, vol. ii, p. 182—204).

servation *; we must not forget, that the cacao-plantations require a much less number of slaves than most others. This consideration is of high importance, at a time, when all the nations of Europe have nobly resolved to put an end to the slave-trade. One slave is sufficient for a thousand trees, which may yield on an average annually twelve fanegas of cacao. It is true, that in the island of Cuba one *large* sugar-plantation with three hundred Blacks, yields, one year with another, forty thousand *arrobas* of sugar, the value of which, at forty piastres the cask †, amounts to a hundred thousand piastres; and that in the province of Venezuela cacao to the value of a hundred thousand piastres, or four thousand fanegas, when the *fanega* is at twenty-five piastres only, requires three hundred or three hundred and thirty slaves. The two hundred thousand casks of sugar, or three million two hundred thousand *arrobas* ‡, which the island of Cuba has annually exported from 1812 to 1814, amount to eight millions of piastres; and might be fabricated with twenty-four thousand slaves, *if the island had only very*

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* See above, chap. viii, vol. iii, p. 192. The cacao of Guayaquil keeps better than that of Caraccas.

† A cask *(caxa)* weighs from fifteen and a half to sixteen arrobas, each arroba = 25 pounds Spanish.

‡ The haciendas of Choroni, Ocumare, Chuao, Turiamo, Guaiguaza.

large plantations; but this supposition is not conformable to the state of the colony, and the nature of things. In 1811 the island of Cuba employed a hundred and forty-three thousand slaves in the fields alone; while the Capitania General of Caraccas, which produces but does not export two hundred thousand fanegas of cacao a year, or to the value of five millions of piastres, has, both in the towns and in the fields, only sixty thousand slaves. It is almost superfluous to add, that these results vary with the prices of sugar and cacao.

The finest plantations of cacao are found in the province of Caraccas along the coast, between Caravalleda and the mouth of the Rio Tucuyo *, in the valleys of Caucagua, Capaya, Curiepe, and Guapo; and in those of Cupira, between Cape Codera and Cape Unare, near Arora, Barquesimeto, Guigue, and Uritucu. The cacao that grows on the banks of the Uritucu, at the entrance of the Llanos, in the jurisdiction of San Sebastian de las Reyes, is considered as of the first quality. Next to the cacao of Uritucu comes that of Guigue, of Caucagua, of Capaya, and of Cupira. The merchants of Cadiz assign the first rank to the cacao of Caraccas, immediately after that of Socomusco;

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* The two provinces of Caraccas and of Nueva Barcelona are disputing this very fertile tract of ground.

and it's price is generally from thirty to forty per cent higher than that of Guayaquil.

It is only since the middle of the seventeenth century, that the Dutch, tranquil possessors of the island of Curassoa, awakened by their smuggling the agricultural industry of the inhabitants of the neighbouring coasts, and that cacao has become an object of exportation in the province of Caraccas. We are ignorant of every thing, that passed in those countries before the establishment of the Biscay Company of Guipuzcoa, in 1728. No precise statistical fact has reached us; we only know, that the exportation of cacao from Caraccas scarcely amounted, at the beginning of the eighteenth century, to thirty thousand *fanegas* a year. From 1730 to 1748, the company sent to Spain eight hundred and fifty-eight thousand nine hundred and seventy-eight *fanegas*, which make on an average forty-seven thousand seven hundred *fanegas* a year; the price of the *fanega* fell in 1732 to forty-five piastres, when it had before kept at eighty piastres! In 1763 the cultivation had so much augmented, that the exportation rose to eighty-thousand six hundred and fifty-nine *fanegas* *. According to the registers of the custom-house at La Guayra, of which I am in possession, the exports, without counting the produce of illicit trade, were

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* Of these 80,659 *fanegas*, 50,319 were sent directly to Spain, 16,364 to La Vera Cruz, 11,160 to the Canaries, and 2316 to the West India islands.

in 1789 of 103,655 *fanegas*
1792 — 100,592
1794 — 111,133
1796 — 75,538
1797 — 70,832

In an official document, taken from the papers of the minister of finance *, " the annual produce *(la cosecha)* of the province of Caraccas is estimated at a hundred and thirty-five thousand *fanegas* of cacao ; thirty-three thousand of which are for home consumption ; ten thousand for other Spanish colonies ; seventy-seven thousand for the mother-country ; fifteen thousand for the illicit commerce with the French, English, Dutch, and Danish colonies. From 1789 to 1793, the importation of cacao from Caraccas into Spain has been, on an average, seventy-seven thousand seven hundred and nineteen *fanegas* a year, of which sixty-five thousand seven hundred and sixty-six have been consumed in the country, and eleven thousand nine hundred and fifty-three exported to France, Italy, and Germany *." According to numerous informations, which I collected on the spot, these estimations are still somewhat too low. The books of the custom-house of La Guayra alone give, on a mean, in time of peace an exportation of eighty thousand or a hundred thousand *fanegas* a year. We may safely augment this sum a fourth or fifth, on account of the illicit trade with Trinidad, and the other West India islands. It appears to me probable, that from 1800 to 1806, the last period of internal tranquillity in the Spanish colonies, the annual produce of the cacao-plantations of the *Capitania General* of Caraccas was at least a hundred and ninety-three thousand *fanegas*; of which we may allot to

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* Report *(MS.)* of the Count of Casa Valencia, counsellor in the Department of the Indies, to Don Pedro Varela, minister of *Real Hacienda*, on the commerce of Caraccas, the 13th June, 1797 (fol. 46).

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* According to the registers of the ports of Spain, the importation of cacao from Caraccas into the peninsula was

in 1789 —— 78,406 *fanegas* 88lbs.
1790 —— 74,089 —— 3
1791 —— 71,500 —— 43
1792 —— 87,656 —— 34
1793 —— 76,983 —— 4
Annual average 77,719 *fanegas*.

Of these 77,719 *fanegas*, 60,202 were consumed in the provinces of Spain not privileged *(provincias contribuyentes)*, and 5564 in the privileged provinces *(provincias exemptas)*, as Navarre, Biscay, &c. The exportation from Spain was

in 1789 —— 13,718 *fanegas* 98lbs.
1790 —— 6,421 —— 80
1791 —— 21,446 —— 17
1792 —— 17,452 —— 48
1793 —— 728 —— 23
Annual average 11,953 *fanegas*.

As in the complicated system of the Spanish custom-houses the cacao of Caraccas is subject to a very different duty, according as it is consumed in the peninsula, or exported out of the kingdom (in the first case, fifty-two and a half per cent, and in the second twenty-nine and a half), a great quantity of cacao is reimported into Spain.

the province of Caraccas . . .	150,000
of Maracaybo . .	20,000
of Cumana . . .	18,000
of Nueva Barcelona .	5,000

The crops that are gathered twice a year, at the end of June and of December, vary much; yet less than those of the olive and vine in Europe. Of the hundred and ninety-three thousand fanegas of cacao, which the *Capitania General* of Caraccas produces, a hundred and forty-five thousand pass over to Europe, either by the ports of the peninsula, or by contraband trade.

I think I can prove*, and these estimations are the result of a great number of local statements, that Europe consumes in it's present state of civilization,

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* For the bases of these estimations, so important in all the researches of political economy, see my *Essai sur la Nouv. Esp.*, vol. ii, p. 431, 435, 436, 658; the tables of exportation from Canton in *Sainte-Croix*, *Voyage commercial aux Indes orientales*, vol. iii, p. 153, 161, 170; Colquhoun, on the Wealth of the British Empire, p. 331, 334; and this Personal Narrative, vol. iv, p. 71. The English West India islands exported of sugar to different parts of the world, in 1812, more than

	Franks.
23 millions of pounds of cacao, at 120 fr. the hundred weight.	27,600,000
32 millions of pounds of tea, at 4 fr. a pound	128,000,000
140 millions of pounds of coffee, at 114 fr. the hundred weight	159,600,000
450 millions of pounds of sugar, at 54 fr. the hundred weight . .	243,000,000
Total value*,	558,200,000

233,000 *hogsheads*, at 14 cwt., or 326,000,000 pounds; of which Jamaica alone, with 350,000 negroes, furnished 189,000,000 pounds. The produce of Cuba and that of St. Domingo together have been estimated at 120,000,000 pounds of sugar. When we state the annual consumption of cacao in Europe at 23,000,000, and that of sugar at 450,000,000 pounds, we think we give the real numbers, exact to one fifth. This degree of precision may be attained by estimating with care the exportation of those countries, that *furnish the greatest quantity* of cacao and sugar for the European trade; for instance, with respect to cacao, the exportation of the ports of Terra Firma, Guayaquil, and Guatimala; and for sugar that of the English, Spanish, and French West India islands. We shall remark on this occasion, that the consumption of sugar is stated, in the statistical tables of France, to amount in 1806 to 51,000,000; in 1817, it was 56,400,000 pounds.

* In 1816, the price of *cacao* at London was, for the *cacao* of Cararcas, from 6*l*. to 6*l*. 10*s*.; for *cacao* of inferior quality,

The first of these four productions, which have become within two or three centuries the principal objects of commerce and colonial industry, belongs exclusively to America; the second to Asia. I say exclusively, for the exportation of cacao from the Philippine Isles is yet of as little importance, as the attempts which have been made to cultivate tea in Brazil, the island of Trinidad, and Jamaica. The united provinces of Caraccas furnish nearly two thirds of all the cacao, that is consumed in the western and southern parts of Europe. This result is the more remarkable, as being contrary to what is generally believed; but the cacao of Caraccas, Maracaybo, and Cumana, is not all of the same quality. We have just seen, that the Count of Casa Valencia estimates the consumption of Spain at only six or seven millions of pounds;

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from 4*l.* 10*s.* to 3*l.* 10*s.* the hundred weight; *coffee* was, at a mean, 95*s.* the hundred weight: *sugar*, from 40*s.* to 50*s.* The price of these last two articles has considerably risen since the publication of Mr. Colquhoun's work. It is difficult to fix a general statement for the price of *tea*, on account of the great difference between the various qualities. In 1817, the importation of sugar from the East Indies into the port of London, was only 50,000 bags, or 5,500,000 pounds. In order to form a more precise idea of the importance of European commerce in sugar, coffee, tea, and cacao, we shall here call to mind, that the value of all the importations of England amounts, from 1805 to 1810, on an average, to 1200 millions of francs yearly.

the Abbé Hervas fixes it at nine millions. Every person, who has long inhabited Spain, Italy, and France, must have observed, that the use of chocolate is frequent only in the first of these countries among the poorer class of people; and therefore will scarcely believe, that Spain consumes but a third of the cacao imported into Europe.

The late wars have had much more fatal effects on the cacao trade of Caraccas, than on that of Guayaquil. On account of the increase of price, less cacao of the first quality has been consumed in Europe. Instead of mixing, as was done formerly for common chocolate, one quarter of the cacao of Caraccas, with three quarters of that of Guayaquil, the latter has been employed pure in Spain. We must here remark, that a great deal of cacao of an inferior quality, such as that of Maranon, the Rio Negro, Honduras, and the island of St. Lucia, bears the name, in commerce, of Guayaquil cacao. The exportation from that port amounts only to 60,000 fanegas; consequently it is two thirds less than that of the ports of the *Capitania General* of Caraccas.

Though the plantations of cacao have augmented in the provinces of Cumana, Barcelona, and Maracaybo, in proportion as they have diminished in the province of Caraccas, it is still believed, that in general this ancient branch of agricultural industry gradually declines. Coffee and cotton-trees progressively take place on many spots of the cacao, of which the lingering harvests weary the patience of the cultivator. It is also asserted, that the new plantations of cacao are less productive than the old; the trees do not acquire the same vigour, and yield later and less abundant fruit. The soil is still accused of being exhausted; but we think it is rather the atmosphere, that is changed by the progress of clearing and cultivation. The air, that reposes on a virgin soil covered with forests, is loaded with humidity, and those gaseous mixtures, that serve for the nutriment of plants, and arise from the decomposition of organic substances. When a country has been long subjected to cultivation, it is not the proportions between the azot and oxygen that vary. The constituent bases of the atmosphere remain unaltered; but it no longer contains, in a state of suspension, those binary and ternary mixtures of carbon, azot, and hydrogen, which a virgin soil exhales, and which are regarded as a source of fecundity. The air, purer and less charged with miasmata and heterogeneous emanations, becomes at the same time dryer. The elasticity of the vapours undergoes a sensible diminution. On land anciently cleared, and consequently little favourable to the cultivation of the cacao-tree, for instance in the West India islands, the fruit is almost as small as that of the wild cacao-tree. It is, as we have already observed, on the banks of the Upper Oroonoko, after having crossed the Llanos, that we find the true country of the cacao-tree; thick forests, in which, on a virgin soil, and surrounded by an atmosphere continually humid, the trees furnish from the fourth year abundant crops. Wherever the soil is not exhausted, the fruit is become by cultivation larger and less bitter, but also more late.

On seeing the produce of cacao diminish gradually in Terra Firma, it may be inquired, whether the consumption will diminish in the same proportion in Spain, Italy, and the rest of Europe; or whether it be not probable, that, by the destruction of the cacao-plantations, the price will augment sufficiently, to rouse anew the industry of the cultivator. This latter opinion is generally admitted by those, who deplore, at Caraccas, the diminution of so ancient and beneficial a branch of commerce. In proportion as civilization extends toward the humid forests of the interior, the banks of the Oroonoko and the Amazon, or toward the valleys that furrow the eastern declivity of the Andes, the new planters will find lands and an atmosphere equally favourable to the culture of the cacao-tree.

It is known, that the Spaniards in general dread the mixture of vanilla with the cacao, as irritating the nervous system; the fruit therefore of that orchideous plant is entirely neglected in the province of Caraccas, though abundant crops of it might be gathered on the humid and feverous coast between Porto Cabello and Ocumare; especially at Turiamo, where the fruits of the *epidendrum vanilla* attain a length of eleven or twelve inches. The English and the Anglo-Americans often seek to make purchases of vanilla at the port of La Guayra, but the merchants procure with difficulty a very small quantity. In the valleys that descend from the chain of the coast toward the Caribbean sea, in the province of Truxillo, as well as in the missions of Guyana near the cataracts of the Oroonoko, a great quantity of vanilla might be collected; the produce of which would be still more abundant, if, according to the practice of the Mexicans, the plant were disentangled from time to time from the creeping plants, by which it is entwined and stifled.

In making known the actual state of the cacao-plantations in the province of Venezuela; discussing the connection that is observed between the produce of those plantations, the humidity of the air, and it's salubrity; we have mentioned the hot and fertile valleys of the Cordillera of the coast. This tract of land, where it stretches on the West toward the lake of Maracaybo, displays a remarkable variety of scenery.

I shall exhibit in one view, to close this chapter, the notions I have been able to acquire respecting the quality of the soil, and the metallic riches of the districts of Aroa, of Barquesimeto, and of Carora.

From the *Sierra Nevada* of Merida, and the *Paramos* of Niquitao, Bocono, and Las Rosas [*], which contain the valuable bark-tree, the eastern Cordillera of New Grenada [†] decreases in height so rapidly, that between the ninth and tenth degrees of latitude it forms only a chain of little mountains, which, stretching to the North-East by the Altar and Torito, separates the rivers that join the Apure and the Oroonoko from those numerous rivers that flow either into the

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[*] Many travellers, who were monks, have asserted, that the little Paramo de Las Rosas, the height of which appears to be more than 1,600 toises, is covered with rosemary, and the red and white roses of Europe, that grow wild there. These roses are gathered to decorate the altars in the neighbouring villages, on the festivals of the church. By what accident has our rosa centifolia become wild in this country, while we no where found it in the Andes of Quito and Peru? Is it really the rose-tree of our garden? See above, vol. iii, p. 487.

[†] The bark exported from the port of Maracaybo does not come from the territory of Venezuela, but from the mountains of Pamplona in New Grenada, being brought down the Rio de San Faustino, that flows into the lake of Maracaybo. (*Pombo, Noticias sobre las Quinas*, 1814, p. 65.) Some is collected near Merida, in the ravine of Viscucucuy.

Caribbean sea or the lake of Maracaybo*. On this *dividing ridge* are built the towns of Nirgua, San Felipe el Fuerte, Barquesimeto, and Tocuyo. The first three are in a very hot climate; but Tocuyo enjoys great coolness, and we heard with surprise, that, beneath so fine a sky, the inhabitants have a strong propensity to suicide. The ground rises toward the South; for Truxillo, the lake of Urao, from which carbonat of soda is extracted, and La Grita, all to the East of the Cordillera, though no farther distant are four or five hundred toises high †.

On examining the law, which the primitive strata of the Cordillera of the coast follow in their dip, we believe we recognize one of the causes of the extreme humidity of the land bounded by this Cordillera and the ocean. The dip of the strata is most frequently to the North-West; so that the waters flow in that direction on the ledges of the rock; and form, as we have stated above, that multitude of torrents and rivers, the inundations of which become so fatal to the health of the inhabitants, from Cape Codera as far as the lake of Maracaybo.

Among the rivers that descend North-East toward the coast of Porto-Cabello, and *La*

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* See ch. xiii, vol. iii, p. 495 and 528.

† The town of Pamplona, more toward the South-West, is elevated, according to Mr. Caldas, 1255 toises above the level of the ocean.

Punta de Hicacos, the most remarkable are those of Tocuyo, Aroa, and Yaracuy. Were it not for the miasmata, that infect the atmosphere, the valleys of Aroa and of Yaracuy would perhaps be more populous than those of Aragua *. Navigable rivers would even give the former the advantage of facilitating the exportation of their own crops of sugar and cacao, and that of the productions of the neighbouring lands; as the wheat of Quibor, the cattle of Monaï, and the copper of Aroa. The mines, from which this copper is extracted, are in a lateral valley, opening into that of Aroa; and which is less hot, and less unhealthy, than the ravines nearer the sea. In the latter the Indians have their gold-washings, and the soil conceals rich copper-ores, which no one has yet attempted to extract. The ancient mines of Aroa, after having been long neglected, have been wrought anew by the care of Don Antonio Henriquez, whom we met at San Fernando on the borders of the Apure. It appears from the information he gave us, that the situation of the ore is a kind of *mass (stockwerck)*, formed by the union of several small veins, which cross each other in every direction. These *masses* are sometimes two or three toises thick. There are three mines, which are all wrought by slaves. The largest mine, the *Biscayna*, has but thirty miners, and the total number of slaves employed in the extraction of the ore, and in smelting it, amounts only to sixty or seventy. As the draining gallery is but thirty toises deep, the waters prevent working the richest parts of the *mass*, which is deeper than the gallery; and no one has hitherto thought of erecting hydraulic wheels. The total produce of metallic copper is twelve or fifteen hundred quintals a year. This copper, known at Cadiz by the name of *Caraccas copper*, is of an excellent quality. It is even preferred to that of Sweden, and of Coquimbo in Chili*. Part of the copper of Aroa is employed in casting bells on the spot. Some ores of silver have been recently discovered between Aroa and Nirgua, near Guanita, in the mountain of San Pablo. Grains of gold are found in all the mountainous lands between the Rio Yaracuy, the town of San Felipe, Nirgua, and Barquesimeto; particularly in the Rio de Santa Cruz, in which the Indian gold-gatherers have sometimes found lumps of the value of four or five piastres. Do the neighbouring rocks of mica-slate and gneiss contain real veins? or is the gold disseminated here, as in the granites of Guadarama in Spain, and of the Fichtelberg in Franconia, throughout the whole mass of the rock? Perhaps the waters, in filtering through it, bring together the disseminated grains of gold; and in this case every attempt to work the rock would be useless. In the *Savana de la Miel*, near the town of Barquesimeto, a shaft has been sunk in a black shining slate resembling ampelite. The minerals extracted from this shaft, which were sent to me at Caraccas, were quartz, pyrites *not auriferous*, and carbonated lead, crystallized in needles of a silky lustre.

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* Urama, Moron, Cabria, San Nicolas, and the valleys of Alpargaton, and Caravinas, are also mentioned as extremely unhealthy.

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* The exportation of Aroa copper from La Guayra, in 1794, was only 11,525 pounds *entered at the custom house;* in 1796, 31,142 pounds; and in 1797, 2,400 pounds. At that time the hundred weight fetched twelve piastres.

We have already observed above, that in the early times of the conquest the working of the mines of Nirgua and of Buria* was begun, notwithstanding the incursions of the warlike nation of the Giraharas. In this very district the accumulation of Negro slaves in 1553 gave rise to an event, which, little important in itself, becomes interesting by the analogy it displays with the events, that are now passing before our eyes in the island of St. Domingo. A Negro slave excited an insurrection among the miners of the Real de San Felipe de Buria.

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* The valley of Buria, and the little river of the same name, communicate with the valley of the Rio Coxede, or Rio de Barquesimeto.

He retired into the woods, and founded, with two hundred of his companions, a town, where he was proclaimed king. *Miguel*, this new king, was a friend to pomp and parade. He caused his wife Guiomar, to assume the title of queen; and, according to Oviedo[*], he appointed ministers and counsellors of state, officers of *la casa real*, and even a Negro bishop. He had soon after the boldness to attack the neighbouring town of Nueva Segovia de Barquesimeto; but, repulsed by Diego de Losada, he perished in the fight. This African monarchy was succeeded at Nirgua by a republic of Zamboes, the descendants of Negroes and Indians. The whole municipality (the *cabildo)* is composed of men of colour, to whom the king of Spain has given the title of "*his faithful and loyal subjects, the Zamboes of Nirgua.*" Few families of Whites will inhabit a country, where the system that prevails is so contrary to their pretensions; and the little town is called in derision *la republica de Zambos y Mulatos.* It is as imprudent, to cede the government to a single *cast*, as to segregate that *cast* by depriving it of it's natural rights.

If the hot vallies of Aroa, of Yaracuy, and of the Rio Tocuyo, celebrated for their excellent timber, be rendered feverous by the luxury of vegetation, and the extreme humidity of the atmosphere, it is not the same in the savannahs or *Llanos of Monai and Carora.* These Llanos are separated by the mountainous tract of Tocuyo and Nirgua from the great *Plaines de la Portuguesa et de Calabozo.* It is a very extraordinary phenomenon to see barren savannahs loaded with miasmata. No marshy ground is found there, but several phenomena indicate a disengagement of hydrogen gas *. When travellers, who are not acquainted with natural inflammable gasses, are shown the *Cueva del Serrito de Monai*, it is usual to frighten them by setting fire to the gaseous mixture, which is constantly accumulated in the upper part of the cavern. May we attribute the insalubrity of the atmosphere to the same causes as in the plains between Tivoli and Rome, to disengagements of sulphuretted hydrogen*? Perhaps also the mountainous lands, that are near the *Llanos of Monai*, have a baneful influence on the surrounding plains. The South-East winds may bring to them the putrid exhalations, that rise from the ravine of Villegas, and from La Sienega de Cabra, between Carora and Carache. I am desirous of collecting every circumstance, which has a relation to the salubrity of the air; for, in a matter so obscure, it is only by the comparison of a great number of phenomena, that we can hope to discover the truth.

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[*] *Hist. de Venezuela*, vol. i, p. 134.

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* What is that luminous phenomenon known under the name of *the lantern (farol) of Maracaybo*, which is perceived every night, toward the seaside as well as in the inland parts, at Merida for example, where Mr. Palacios observed it during two years? The distance, greater than 40 leagues, at which the light is distinguished, has led to the supposition, that it might be owing to the effects of a thunderstorm, or of electrical explosions, which might daily take place in a pass in the mountains. It is asserted, that, on approaching the *farol*, the rolling of thunder is heard. Others vaguely pretend, that it is an air-volcano; and that asphaltic soils, like those of Mena, cause these inflammable exhalations so constant in their appearance. The phenomenon takes place on a mountainous and uninhabited spot, on the borders of the Rio Catatumbo, near it's junction with the Rio Sulia. The place of the *farol* is such, that, being nearly in the meridian of the opening (*boca*) of the lake of Maracaybo, navigators are guided by it as by a lighthouse.

The barren yet feverous savannahs, that extend from Barquesimeto to the eastern shore of the lake of Maracaybo, are partly covered with cactus; but the good silvester cochineal, known by the vague name of *grana de Carora*, comes from a more temperate region, between Carora and Truxillo, and particularly from the valley of the Rio Mucuju*, to the East of Merida. The inhabitants neglect altogether this production, so much sought for in commerce.

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* Don Carlos del Pozo has discovered in this district, at the bottom of the *Quebrada de Moroturo*, a stratum of clayey earth, black, strongly soiling the fingers, emitting a strong smell of sulphur, and inflaming spontaneously, when slightly moistened and exposed for a long time to the rays of the tropical Sun; the detonation of this muddy substance is very violent.

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* This little river descends from the Paramo de los Conejos, and flows into the Rio Albarregas.

NOTES

TO

THE FIFTH BOOK.

NOTE A.

The following are some remarkable passages in the letter from Aguirre to the king of Spain.

"King Philip, native of Spain, Son of Charles the Invincible! I, Lopez de Aguirre, thy vassal, an old Christian, of poor but noble parents, and native of the town of Onate in Biscay, passed over young to Peru, to labour lance in hand. I rendered thee great services in the conquest of India. I fought for thy glory, without demanding pay of thy officers, as is proved by the books of thy treasure. I firmly believe, Christian King and Lord, very ungrateful to me and my companions, that all those, who write to thee from this land (America), deceive thee much, because thou seest things too far off. I recommend to thee, to be more just toward the good vassals, whom thou hast in this country; for I and mine, wearied of the cruelties and injustice, which thy viceroys, thy governors, and thy judges, exercise in thy name, are resolved to obey thee no more. We regard ourselves no longer as Spaniards. We make a cruel war on thee, because we will not endure the oppression of thy ministers; who, to give places to their nephews and their children, dispose of our lives, our reputation, and our fortune. I am lame in the left foot from two shots of an arquebuse, which I received in the valley of Coquimbo, fighting under the orders of thy marshal, Alonzo de Alvarado, against Francis Hernandez Giron, then a rebel, as I am at present, and shall be always; for since thy viceroy, the Marquis of Canete, a cowardly, ambitious, and effeminate man, has hanged our most valiant warriors, I care no more for thy pardon than for the books of Martin Luther. It is not well in thee, King of Spain, to be ungrateful toward thy vassals; for, it was while thy father, the emperor Charles, remained quietly in Castille, that they procured for thee so many kingdoms and vast countries. Remember, King Philip, that thou hast no right to draw revenues from these provinces, the conquest of which has been without danger to thee, but inasmuch as thou recompensest those, who have rendered thee such great services. I am certain, that few Kings go to Heaven. Therefore we regard ourselves as very happy, to be here in the Indies, preserving in all their purity the commandments of God, and of the Roman church; and we intend, though sinners during life, to become one day martyrs to the glory of God. On going out of the river of Amazons, we landed in an island called La Margaretta. We there received news from Spain of the great faction and machination *(maquina)* of the Lutherans. This news frightened us extremely; we found among us one of that faction; his name was Monteverde. I had him cut to pieces, as was just: for believe me, signior, wherever I am, people live according to the law. But the corruption of morals among the monks is so great in this land, that it is necessary to chastise it severely. There is not an ecclesiastic here, who does not think himself higher than the governor of a province. I beg of thee, great King, not to believe what the monks tell thee down yonder in Spain. They are always talking of the sacrifices they make, as well as of the hard and bitter life they are forced to lead in America; while they occupy the richest lands, and the Indians hunt and fish for them every day.

If they shed tears before thy throne, it is that thou mayest send them hither to govern provinces. Dost thou know what sort of life they lead here? given up to luxury, acquiring possessions, selling the sacraments, being at once ambitious, violent, and gluttons; such is the life they lead in America. The faith of the Indians suffers by such bad examples. If thou dost not change all this, O king of Spain, thy government will not be stable.

"What a misfortune, that the Emperor, thy father, has conquered Germany at such a price, and has spent on that conquest the money, that we procured for him in these very Indies! In the year 1559, the Marquis of Canete sent to the Amazons Pedro de Ursua, a Navarrese, or rather a Frenchman: we sailed on the largest rivers of Peru, till we came to a gulf of fresh water. We had already gone three hundred leagues, when we killed that bad and ambitious captain. We chose a *cavallero* of Seville, Fernand de Guzman, for king; and we swore fealty to him, as is done to thyself. I was named quarter-master general: and because I did not consent to all his will, he wanted to kill me. But I killed this new king, the captain of his guards, his lieutenant-general, his chaplain, a woman, a knight of the order of Rhodes, two ensigns, and five or six domestics of the pretended king. I then resolved to punish thy ministers, and thy *auditors* (counsellors of the *audiencia*). I named captains and sergeants: these again wanted to kill me, but I had them all hanged. In the midst of these adventures, we navigated eleven months, till we reached the mouth of the river. We sailed more than 1500 leagues. God knows how we got through that great mass of water. I advise thee, O great king, never to send Spanish fleets into that cursed river. God preserve thee in his holy keeping."

This letter was given by Aguirre to the vicar of the island of Margaretta, Pedro de Contreras, in order to be transmitted to king Philip II. Fray Pedro Simon, provincial of the order of St. Francis in New Grenada, saw several manuscript copies of it in America, and in Spain. It was printed for the first time, in 1723, in the History of the Province of Venezuela by Oviedo, vol. i, p. 206. Complaints no less violent, on the conduct of the monks of the 16th century, were addressed directly to the Pope by the Milanese traveller, Girolamo Benzoni.

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NOTE B.

The milk of the lactescent agarics has not been separately analysed; it contains an acrid principle in the agaricus piperatus; and in other species it is sweet and harmless. The fine experiments of Messrs. Braconnot, Bouillon-Lagrange, and Vauquelin (*Annales de Chimie*, vol. xlvi, p. 211; vol. li, p. 75; vol. lxxix, p. 265; vol. lxxx, p. 272; vol. lxxxv, p. 5), have pointed out a great quantity of albumen in the substance of the agaricus deliciosus, an edible mushroom. It is this albumen contained in their juice, which renders them so hard when boiled. I have mentioned above the experiments I made in 1796, to prove, that morels (*morchella esculenta*) can be converted into a *sebaceous* and *adipocerous* matter, capable of being used in the fabrication of soap. (*De Candolle, sur les Propriétés méd. des Plantes*, p. 345.) The saccharine matter had already been found in mushrooms, in 1791, by Mr. Gunther (See my *Aphorismi ex Physiologia chem. Plantarum*, in the *Flora Friberg*, p. 175). It is in the family of the *fungi*, more especially in the clavariæ, phalli, helvetiæ, the merulii and the small gymnopæ which display themselves in a few hours after a storm of rain, that organic nature produces with most rapidity the greatest variety of chemical principles, sugar, albumen, adipocire, acetat of potash, fat, ozmazome, the aromatic principles, &c. It would be interesting to examine, beside the milk of the
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lactescent fungi, those species, which, when cut in pieces, change their colour at the contact of atmospheric air.

Though we have referred the *palo de vaca* to the family of the sapotas, we have nevertheless found in it a great resemblance with some plants of the urticeous kind, especially with the fig-tree, because of it's terminal stipulæ in the shape of a horn; and with the brosimum, on account of the structure of it's fruit. Mr. Kunth would even have preferred this last classification; if the description of the fruit, made on the spot, and the nature of the milk, which is acrid in the urticeæ, and sweet in the sapotas, did not seem to confirm the conjecture, which we have advanced above, p. 215. Mr. Bredemeyer saw, like us, the fruit, and not the flower of the cow-tree. He asserts, that he observed (sometimes ?) two seeds, lying one against the other, as in the alligator pear-tree *(laurus persea)*. Perhaps this botanist had the intention of expressing the same conformation of the *nucleus*, that *Swartz* indicates in the description of the brosimum: *nucleus bilobus aut bipartibilis*. We have mentioned the places where this remarkable tree grows: it will be easy for botanical travellers to procure the flower of the *palo de vaca*, and to remove the doubts, which still remain, of the family to which it belongs.

BOOK VI.

CHAPTER XVII.

Mountains that separate the valleys of Aragua from the Llanos of Caraccas.—Villa de Cura.—Parapara.—Llanos, or Steppes.—Calabozo.

The chain of mountains, that borders the lake of Tacarigua toward the South, forms in some sort the northern shore of the great basin of the Llanos or savannahs of Caraccas. In order to descend from the valleys of Aragua into these savannahs, the mountains of Guigue and of Tucutunemo must be crossed. From a peopled country embellished by cultivation, we plunge into a vast solitude. Accustomed to the aspect of rocks, and to the shade of valleys, the traveller beholds with astonishment these savannahs without trees, these immense plains, that seem to ascend toward the horizon.

Before I trace the scenery of the Llanos, or of the region of pasturage*, I shall succinctly describe the road we took from Nueva Valencia, by Villa de Cura and San Juan, to the little village of Ortiz, placed at the entry of the steppes. We left the valleys of Aragua on the 6th of March before sunrise. We passed over a plain richly cultivated, keeping along the South-West side of the lake of Valencia, and crossing the ground that the waters of the lake had left uncovered. We were never weary of admiring the fertility of the soil, covered with calebashes, water-melons, and plantains. The rising of the Sun was announced by the distant noise of the howling monkeys. Approaching a group of trees, that rise in the midst of the plain, between the ancient islets of Don Pedro and La Negra, we perceived numerous bands of araguatoes going as in procession from one tree to another, with extreme slowness. A male was followed by a great number of females, several of which carried their young on their shoulders. Naturalists have very often described the howling monkeys, that live in society in different parts of America. They every where resemble each other in their manners, though the species are not always the same. The uniformity with which the araguatoes execute their movements is extremely striking *. Whenever the branches of neighbouring trees do not touch, the male that leads the band suspends himself by the callous

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* See above, chap. xii, vol. iii, p. 424.

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* Simia ursina. (See chap. viii, vol. iii, p. 170.)

and *prehensile* part of his tail; and, letting fall the rest of his body, swings himself till in one of his oscillations he reaches the neighbouring branch. The whole file performs the same action on the same spot. It is almost superfluous to add how dubious is the assertion of Ulloa[*], and so many well-informed travellers, according to whom, the marimondoes[†], the araguatoes, and other monkeys with a *prehensile* tail, form a sort of chain, in order to reach the opposite side of a river. We had opportunities, during five years, of observing thousands of these animals; and for this very reason we place no confidence in relations, perhaps invented by the Europeans themselves, though repeated by the Indians of the missions, as if they had been transmitted to them by their fathers. Man, the most remote from civilization, enjoys the astonishment he excites in recounting the marvels of his country. He says he has seen what he imagines may have been seen by others. Every savage is a hunter, and the stories of hunters borrow from the imagination in proportion as the animals, of which they boast the artifices, are endowed with a higher degree of intelligence. Thence the fictions, of which foxes, monkeys, crows, and the condor of the Andes, have been the subjects in the two hemispheres.

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[*] This celebrated traveller has not hesitated to represent in an engraving this extraordinary feat of the monkeys with a *prehensile* tail.—See *Viage a la America meridional (Madrid,* 1748), vol. i, p. 144—149.

[†] Simia belzebuth. See my *Obs. de Zool.*, vol. i, p. 327.

The araguatoes are accused of sometimes abandoning their young, that they may be lighter for flight when pursued by the Indian hunters. It is said, that mothers have been seen taking off their young from their shoulders, and throwing them down to the foot of the tree. I am inclined to believe, that a movement merely accidental has been mistaken for one that was premeditated. The Indians have a hatred or predilection for certain races of monkeys; they love the viuditas, the titis, and generally all the little sagoins; while the araguatoes, on account of their mournful aspect, and their uniform howlings, are at once detested and calumniated. In reflecting on the causes, that may facilitate the propagation of sound in the air during the night, I thought it important to determine with precision the distance, at which, especially in damp and stormy weather, the howling of a band of araguatoes is heard. I believe I obtained proof of it's being distinguished at eight hundred toises distance. The monkeys that are furnished with four hands cannot make excursions in the Llanos; and it is easy, amid vast plains covered with grass, to recognize a solitary group of trees, whence the noise issues, and which is inhabited by howling monkeys. Now by approaching or withdrawing from this group of trees, the *maximum* of the distance may be measured, at which the howling is heard. These distances appeared to me sometimes a third greater during the night, especially when the weather was cloudy, very hot, and humid.

The Indians pretend, that, when the araguatoes fill the forests with their howlings, there is always one that chaunts as *leader of the band.* The observation is pretty accurate. During a long time one solitary and strong voice is generally distinguished, till it's place is taken by another voice of a different pitch. We may observe from time to time the same instinct of imitation among frogs, and almost all animals that live and exert their voices in society. The missionaries farther assert, that, when a female among the araguatoes is on the point of bringing forth, the choir suspends it's howlings till the moment of the birth of the young. I could not myself judge of the accuracy of this assertion; but I do not believe it to be entirely destitute of foundation. I have observed, that, when an extraordinary incident, the moans for instance of a wounded araguato, fixed the attention of the band, the howlings were for some minutes suspended. Our guides assured us gravely, that, "to cure an asthma, it is sufficient to drink out of the bony drum of the hyoidal bone of the araguato." This animal, having so extraordinary a volume of voice, it's larynx must necessarily impart to the water poured into it the virtue of curing the affections of the lungs. Such is the science of the vulgar, which sometimes resembles that of the ancients.

We passed the night at the village of Guigue, the latitude of which I found by observations of Canopus to be 10° 4′ 11″. The village, surrounded with the richest cultivation, is only a thousand toises distant from the lake of Tacarigua. We lodged with an old sergeant, a native of Murcia, a man of a very original character. To prove to us, that he had studied among the Jesuits, he recited to us the history of the creation of the world in Latin. He knew the names of Augustus, Tiberius, and Dioclesian; and while enjoying the agreeable coolness of the night in an enclosure planted with bananas, he interested himself in all that had passed at the court of the Roman emperors. He inquired of us with earnestness for a remedy for the gout, from which he suffered cruelly. "I know," said he, "that a Zambo of Valencia, who is a famous *curioso*, could cure me; but the Zambo would expect to be treated with attentions, that I cannot pay to a man of his colour, and I prefer remaining as I am."

On leaving Guigue we began to ascend the chain of mountains, that extends to the South of the lake toward Guacimo and La Palma. From the top of a table-land, at three hundred and twenty toises of elevation, we saw for the last time the valleys of Aragua. The gneiss appeared uncovered, presenting the same direction of strata, and the same dip toward the North-West. Veins of quartz, that traverse the gneiss, are auriferous; and hence the neighbouring ravine bears the name of *quebrada del oro.* We heard with surprise at every step the name of *ravine of gold,* in a country where only one single mine of copper is wrought. We travelled five leagues to the village of Maria Magdalena, and two leagues more to the *Villa de Cura.* It was Sunday, and at the village of Maria Magdalena the inhabitants were assembled before the church. They wanted to force our muleteers to stop, and hear mass. We resolved to remain; but, after a long altercation, the muleteers pursued their way. I ought to add, that this is the only dispute in which we were engaged from such a motive. Very erroneous ideas are formed in Europe of the intolerance, and even of the religious fervour of the Spanish colonists!

San Luis de Cura, or, as it is commonly called, the *Villa de Cura,* is founded in a very barren valley, lying North-West and South-East, and elevated, according to my barometrical observations, two hundred and sixty-six toises above the level of the ocean. The country, with the exception of some fruit-trees, is almost destitute of vegetation. The dryness of the flat is so much the greater, because several rivers, which is rather extraordinary in a country of primitive rocks, lose themselves in crevices in the ground. The Rio de Las Minas, North of the Villa de Cura, disappears in a rock, again appears, and is ingulfed anew without reaching the lake of Valencia, toward which it flows. Cura resembles a village more than a town. The population is only four thousand souls; but we found many persons of highly cultivated minds. We lodged with a family, which had excited the resentment of government in the revolution at Caraccas in 1797. One of the sons, after having languished in a dungeon, had been sent to the Havannah, to be shut up in a strong fortress. With what joy his mother heard, that, after our return from the Oroonoko, we should visit the Havannah! She entrusted me with five piastres, "the whole fruit of her savings." I earnestly wished to return them to her; but how could I help fearing to wound her delicacy, to give pain to a mother, who finds a charm in the privations she imposes on herself? All the society of the town was assembled in the evening, to admire in a magic lantern the views of the great capitals of Europe. We were shown the palace of the Tuileries, and the statue of the great Elector at Berlin. It excites a singular sensation, to gaze on our native city in a magic lantern, when we are at a distance of two thousand leagues from it!

An apothecary, who had been ruined by an unhappy propensity for working of mines, accompanied us in our excursion to the Serro de Chacas, very rich in auriferous pyrites. We continued to descend the southern declivity of the Cordillera of the coast, in which the plains of Aragua form a longitudinal valley. We passed a part of the night of the 11th at the village of San Juan, remarkable for it's thermal waters; and the singular form of two neighbouring mountains, called the *Morro's of San Juan.* These form slender peaks, that rise from a wall of rocks with a very extensive basis. The wall is perpendicular, and resembles the *Devil's Wall,* which surrounds a part of the group of mountains in the Hartz *. These being perceived from afar in the Llanos, affect the imagination of the inhabitants of the plain, who are not accustomed to the least unequal ground, and the height of the peaks is singularly exaggerated by them. They were described to us as being placed in the middle of the steppes, which they in reality bound toward the North, far beyond a range of hills called *La Galera.* Judging from angles taken at a distance of two miles, these hills are scarcely more than a hundred and fifty-six toises higher than the village of San Juan, and three hundred and fifty toises above the level of the Llanos. The thermal waters glide out at the foot of these hills, which are formed of transition limestone; they are impregnated with sulphuretted hydrogen, like those of Mariara, and form a little pool, or *laguna,* in which the thermometer rose only to 31·3°.

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* Die *Teufels Maner,* near Wernigerode in Germany.

I found in the night of the 9th of March, by very satisfactory observations of the *stars,* the latitude of Villa de Cura to be 10° 2′ 47″. The Spanish officers, who carried astronomical instruments to the Oroonoko, on the expedition for assigning boundaries in 1755, certainly took no observations at Cura, for the map of Caulin, and that of La Cruz Omedilla, place this town a quarter of a degree too far South.

The Villa de Cura is celebrated in the country for the miracles of an image of the Virgin, known by the name of *Nuestra Senora de los Valencianos.* This image, found in a ravine by an Indian, about the middle of the eighteenth century, was the object of a contest between the towns of Cura and San Sebastian de Los Reyes. The vicars of this last town asserted, that the Virgin had made her first appearance on the territory of their parish. The Bishop of Caraccas, in order to put an end to the scandal of this long dispute, caused the image to be placed in the archives of his bishoprick, and kept it thirty years under seal. It was not restored to the inhabitants of Cura, till 1802. Mr. Depons has related at large the circumstances of this singular cause *.

After having bathed in the little river of San Juan, the bottom of which is of basaltic *gruenstein*, in cool and limpid water, we continued our journey at two in the morning, by Ortiz and Parapara, to the *Mesa de Paja*. The road of the Llanos being at that time infested with robbers, several travellers joined us, in order to form a sort of caravan. We continued going down hill during six or seven hours; and we skirted the *Cerro de Flores*, near which the road turns off, that leads to the great village of San Jose de Tisnao. We passed the farms of Luque and Juncalito, to enter the valleys, which, on account of the bad road, and the blue colour of the slates, bear the names of *Malpasso* and *Piedras azules*.

This ground forms the ancient shore of the great basin of the Steppes, and furnishes interesting researches to the geologist. We there find trap formations, which, probably more recent than the veins of diabasis near the town of Caraccas, seem to belong to the rocks of igneous formation. They are not long and narrow streams, as in a part of Auvergne, but large sheets, streams that appear like real strata. The lithoid masses cover here, if we may use the expression, the shore of the ancient interior sea; whatever is subject to destruction, the liquid dejections, the scoriæ filled with bubbles, have been carried away. These phenomena become particularly worthy of attention by the intimate relations that are observed between the phonolites and the amygdaloids, which indubitably containing pyroxenes and hornblende *gruensteins*, form strata in a transition slate. In order to have an accurate idea of the whole of the situation and superposition of these rocks, we shall name the formations as they occur in a profile drawn from North to South.

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* Vol. iii, p. 178.

We find at first in the Sierra de Mariara, which belongs to the northern branch of the Cordillera of the coast, a coarse-grained *granite;* then, in the valleys of Aragua, on the borders of the lake, and in the islands it contains, as well as in the southern branch of the chain of the coast, *gneiss* and *mica-slate.* These last two rocks are auriferous in the *Quebrada del Oro*, near Guigue; and between Villa de Cura and the *Morros de San Juan,* in the mountain of Chacao. The gold is contained in pyrites, which are found sometimes disseminated almost imperceptibly in the whole mass of the gneiss *, and sometimes united in small veins of quartz. Most of the torrents that traverse the mountains bear along with them grains of gold. The poor inhabitants of Villa de Cura and San Juan have sometimes gained thirty piastres a day by washing the sand; but most commonly, in spite of their industry, they do not in a week find particles of gold of the value of two piastres, and therefore few persons devote themselves to this uncertain occupation. Here, however, as in every place, where native gold and auriferous pyrites are disseminated in the rock, or, by the destruction of the rocks, are deposited in alluvial lands, the people conceive the most exaggerated ideas of the metallic riches of the soil. But the success of the workings, which depends less on the abundance of the ore in a vast space of land, than on it's accumulation in one point, has not justified these favourable prepossessions. The mountains of Chacao, bordered by the ravine of Tucutunemo, rises seven hundred feet above the village of San Juan. It is formed of gneiss, which, especially in the superior strata, passes into mica-slate. We saw the remains of an ancient mine, known by the name of *Real de Santa Barbara*. The works were directed to a stratum of cellular quartz *, full of polyedric

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* The four metals, which are found disseminated in the

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granite rocks, as if they were of *contemporaneous* formation, are gold, tin, titanium, and cobalt.

* This stratum of quartz, and the gneiss in which it is

cavities, mixed with iron ocre, containing auriferous pyrites and small grains of gold, sometimes, it is said, visible to the naked eye. It appears, that the gneiss of the Cerro de Chacao furnishes still another metallic deposite, a mixture of copper and silver ores. This deposite has been the object of works attempted with great ignorance, by some Mexican miners, under the superintendance of Mr. Avalo. The gallery* directed to the North-East, is only twenty-five toises long. We there found some fine specimens of blue carbonated copper, mingled with sulphat of barytes and quartz ; but we could not ourselves judge, whether the ore contained any argentiferous *fahlerz*, and whether it occurred in a stratum, or, as the apothecary who was our guide asserted, in real veins. This much is certain, that the attempt at working the mine cost more than twelve thousand piastres in two years. It would no doubt have been more prudent, to have resumed the works on the auriferous stratum of the Real de Santa Barbara.

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contained, lie hor. 8 of the Freyberg compass, and dip 70° to the South-West. At a hundred toises distance from the auriferous quartz, the gneiss resumes it's ordinary situation, hor, 3—4, with 60° dip to the North-West. A few strata of gneiss abound in silvery mica, and contain, instead of garnets, an immense quantity of small octaedrons of pyrites. This silvery gneiss resembles that of the famous mine of Himmelsfuerst, in Saxony.

* *La Cueva de los Mexicanos.*

The *zone of gneiss*, which we have just mentioned, is, in the chain of the coast, from the sea to the Villa de Cura, ten leagues broad. In this great extent of land, gneiss and mica-slate are found exclusively, and these constitute one formation *. Beyond the town of Villa de Cura and the Cerro de Chacao, the aspect of the country becomes more varied to the eye of the geognost. There are still eight leagues of declivity from the table-land of Cura, to the entry of the Llanos; and, on the southern slope of the mountains of the coast, four different formations of rock cover the gneiss. We shall first give their description, without grouping them according to systematic ideas.

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* A formation which we shall call *gneiss-micaslate*, and which is peculiar to the *chain of the coast of Caraccas*. Five formations must be distinguished, as Messrs. von Buch and Raumer have so ably demonstrated in their excellent papers on Landeck and the Riesengebirge, namely (a) *granite;* (b) *granite-gneiss ;* (c) *gneiss ;* (d) *gneiss-micaslate ;* (e) *mica-slate.* The geognosts, whose researches have been confined to a small tract of land, having confounded these formations, which nature has separated in several countries in the most distinct manner, have admitted, that the *gneiss* and mica-slate alternate *every where* in superimposed beds, or furnish insensible transitions from one rock to the other. These transitions and alternating superpositions take place no doubt in formations of *granite-gneiss*, and *gneiss-micaslate ;* but because these phenomena are obseived in one region, it does not follow, that in other regions we do not find very distinct, circumscribed formations of *granite, gneiss*, and *mica-slate.* The same considerations may be applied to the formations of serpentine; which are sometimes isolated, and sometimes belong to the eurite, mica-slate, and *gruenstein.*

On the South of the Cerro de Chacao, between the ravine of Tucutunemo and Piedras Negras, the gneiss is concealed beneath a formation of *serpentine*, of which the composition varies in the different superimposed strata. Sometimes it is very pure, very homogeneous, of a dusky olive green, and of a conchoidal fracture passing to even: sometimes it is veined, mixed with bluish steatite, of an unequal fracture, and containing spangles of mica. In both these states I could not discover in it either garnets, hornblende, or diallage. Advancing farther toward the South, and we always passed over this ground in that direction, the green of the serpentine grows deeper, and feld-spar and horneblende are recognized in it: it is difficult to determine, whether it pass into diabasis *(gruenstein)*, or alternate with it. There is no doubt however, of it's containing veins of copper ore*. At the foot of this mountain two fine springs gush out from the serpentine. Near the village of St. Juan, the *granular diabasis* appears alone uncovered, and takes a greenish black hue. The feld-spar, intimately mixed with the mass, may be separated into distinct crystals. The mica is very rare, and there is no quartz. The mass assumes at the surface a yellowish crust, like dolerite and basaltes.

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* One of these veins, on which two shafts have been sunk, was directed hor. 2·1, and dipped 80° East. The strata of the serpentine, where it is stratified with some regularity, run hor 8, and dip almost perpendicularly. I found malachite disseminated in this serpentine, where it passes into *gruenstein.*

In the midst of this tract of trap-formation, the *Morros of San Juan* rise like two castles in ruins. They appear linked to the *mornes* of St. Sebastian, and to *La Galera,* which bounds the Llanos like a rocky wall. The *Morros of San Juan* are formed of limestone of a crystalline texture; sometimes very compact, sometimes spongy, of a greenish gray, shining, composed of small grains, and mixed with scattered spangles of mica. This limestone yields a strong effervescence with acids. I could not find in it any vestige of organized bodies. It contains, in *subordinate strata,* masses of hardened clay, of a blackish blue, and carburetted. These masses are fissile, very heavy, and loaded with iron; their streak is whitish, and they produce no effervescence with acids. They assume at their surface, by their decomposition in the air, a yellow colour. We seem to recognize in these argillaceous strata a tendency either toward the *transition-slates,* or toward the *kieselschiefer* (schistoid jasper) which everywhere characterize the *black transition limestones.* When in fragments, they might be taken at first sight for basaltes, or hornblendes *. Another white limestone, compact, and containing some fragments of shells, backs the *Morros de San Juan.* I could not see the line of junction of these two limestones; or that of the calcareous formation and the diabasis.

The transverse valley, that descends from Piedras Negras and the village of San Juan toward Parapara and the Llanos, is filled with trappean rocks, displaying close relations with the formation of *green slates*, which they cover. Sometimes we seem to see serpentine, sometimes *gruenstein*, and sometimes dolerites and basaltes. The arrangement of these problematical masses is not less extraordinary. Between San Juan, Malpasso, and Piedras Azules, they form strata parallel to each other, and dipping regularly to the North at an angle of 40° or 50°; they cover, even in *concordant stratification*, the green slates. Lower down, toward Parapara and Ortiz, where the amygdaloids and phonolites are connected with the *gruenstein*, every thing assumes a basaltic aspect. Balls of *gruenstein*, heaped upon one another, form those rounded cones, that are found so frequently in the Mittelgebirge in Bohemia, near Bilin, the country of phonolites. The following is the result of my partial observations.

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* I had an opportunity of examining again, with the greatest care, the rocks of San Juan, of Chacao, of Parapara, and of Calabozo, during my stay at Mexico; where I formed, conjointly with Mr. del Rio, one of the most distinguished pupils of the school of Freyberg, a geognostical collection for the *Colegio de Mineria* of New Spain.

The *gruenstein*, which at first alternated with strata of serpentine, or was connected with this rock by insensible transitions, is seen alone, sometimes in strata considerably inclined, and sometimes in balls with concentric strata, imbedded in strata of the same substance. It lies, near Malpasso, on *green slates*, steatitic, mingled with hornblende, destitute of mica and grains of quartz, dipping *like the gruensteins* 45° toward the North, and directed *like* them N. 75° W.

A great sterility prevails where these green slates predominate, no doubt on account of the magnesia they contain; which (as is proved by the magnesian limestone of England *) is very inimical to vegetation. The dip of the green slates remains the same; but by degrees the direction of their strata becomes parallel to the general direction of the primitive rocks of the chain of the coast. At *Piedras Azules*, these slates, mingled with hornblende, cover in *con-*

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* *Magnesian limestone*, straw yellow, with madrepores; beneath red marl, or muriatiferous red sandstone.

cordant stratification. a blackish blue slate *; very fissile, and traversed by small veins of quartz. The green slates *include some strata of gruenstein*, and they even contain balls of this substance. I nowhere saw the green slates alternate with the black slates of the ravine of *Piedras Azules*; at the line of junction, these two slates appear rather to pass one into the other, the green slates becoming of a pearl-gray in proportion as they lose their hornblende.

Farther South, toward Parapara and Ortiz, the slates disappear. They are concealed under a trap formation more varied in it's aspect. The soil becomes more fertile; the rocky masses alternate with strata of clay, which appear to be produced by the decomposition of the *gruensteins, the amygdaloids, and the phonolites*.

The *gruenstein*, which farther North was less granulous, and passed into serpentine, here assumes a very different character. It contains balls of *mandelstein*, or *amygdaloid*, of eight or ten inches diameter. These balls, sometimes a little flattened, are divided into concentric layers. This is the effect of decomposition. The nucleus is almost as hard as basalt. They are intermingled with little cavities, owing to bubbles of gas, filled with green earth, and crystals of pyroxene and mesotype. Their basis is grayish blue, rather soft, and displays small white spots, which, by the regular form they affect, I should conceive to be decomposed feld-spar. Mr. von Buch has examined with a powerful lens the species we brought. He has discovered, that each crystal of pyroxene, envelopped in the earthy mass, is separated from it by fissures parallel to the sides of the crystal. These fissures seem to be the effect of a contraction, which the mass or basis of the *mandelstein* has undergone. I sometimes saw these balls of *mandelstein* arranged in strata, and separated from each other by beds of *gruenstein* of ten or fourteen inches thick; sometimes (and this situation is the most common) the balls of *mandelstein*, two or three feet in diameter, are found in heaps, and form little mounts with rounded summits, like the spheroidal basaltes. The clay, which separates these amygdaloid concretions, arises from the decomposition of their crust. They acquire by the contact of the air a very thin coating of yellow ochre.

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* The two formations of green and blackish blue slates are directed N. 52° E. (or hor. 3·4), and dip 70° N. W.

South-West of the village of Parapara rises the little Cerro de Flores, which is distinguished from afar in the steppes. Almost at it's foot, and in the midst of the *mandelstein* tract, which we have just been describing, a porphyritic phonolite, a mass of compact feld-spar, of a greenish gray, or mountain green, containing long crystals of vitreous feld-spar, appears exposed. It is the real *porphyrschiefer* of Werner; and it would be difficult to distinguish, in a collection of stones, the phonolite of Parapara from that of Bilin in Bohemia. It does not however here form rocks with grotesque shapes, but little hills covered with tabular blocks, large plates extremely sonorous, translucid on the edges, and wounding the hands when broken.

Such are the successions of rocks, which I described on the spot, as I progressively found them, from the lake of Tacarigua to the entrance of the steppes. Few places in Europe display a *geological constitution* so well worthy of being studied. We saw there in succession six formations:

mica-slate gneiss;
green slate (transition);
black limestone (transition);
serpentine and gruenstein;
amygdaloid (with pyroxene); and
phonolite.

I must observe in the first place, that the substance, which we have just described under the name of *gruenstein*, in every respect resembles that, which forms layers in the mica-slate of Cape Blanc, and veins near Caraccas *. It differs only by containing neither *quartz*, nor garnets, nor pyrites. The intimate relations, that we observed near the *Cerro de Chacao*, between the *gruenstein* and the serpentine, cannot surprise these geognosts, who have studied the mountains of Franconia and Silesia. Near Zobtenberg *, a serpentine rock alternates also with *gabbro*. In the country of Glatz, the fissures of the *gabbro* are filled with a steatite of a greenish white colour; and the rock, which was long thought to belong to the gruensteins †, is an intimate mixture of feld-spar and diallage.

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* See above, vol. iii, p. 405; and p. 59 of the present volume.

The gruensteins of Tucutunemo, which we consider as constituting the same formation with the serpentine rock, contain veins of malachite and copper pyrites. These same *metalliferous situations* are found also in Franconia in the gruensteins of the mountains of Steben and Lichtenberg. With respect to the *geeen slates* of Malpasso, which bear all the characters of *transition slates,* they are identical with those, which Mr. von Buch has so well described, near Schœnau in Silesia. They contain beds of *gruenstein,* like the slates of the mountains of Steben, which we have just mentioned *. The black limestone of the Morros de San Juan, is also a transition limestone. It forms perhaps a subordinate stratum in the slates of Malpasso. This situation would be analogous to what is observed in several parts of Switzerland†. The *slaty zone,* the centre of which is the ravine of *Piedras Azules,* appears divided into two formations. On some points we think we observe one passing into the other. The gruensteins, which begin again to the South of these slates, appear to me to differ little from those found

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* Between Tampadel and Silsterwiz (Buch, Geogn. Beob. vol. i, p. 69; and *Naturf. Freunde zu Berlin*, 1810, vol. iv, p. 144).

† *Leop. de Buch, Descr. de Landeck*, translated by Mr. d'Aubuisson, p. 26. In the mountains of Bareith, in Franconia, so abundant in *gruenstein* and *serpentine*, these two formations are not connected together. The serpentine there belongs rather to the schistoid hornblende (*hornblendschiefer*), as in the island of Cuba. Near Guanaxuato, in Mexico, I saw it alternating with *syenite*. These phenomena of serpentine rocks forming layers in eurite (*weisstein*), in schistoid hornblende, in *gabbro*, and in syenite, are so much the more remarkable, as the great mass of garnetiferous serpentines, which are found in the mountains of gneiss and mica-slate, form little distinct mounts, masses not *covered* by other formations. It is not the same in the mixtures of serpentine and granulous limestone.

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* *Buch,* as above, vol. i, p. 75. On advancing into the adit for draining the mine (*Friedrich-Wilhelmstollen*), which I caused to be begun in 1794, near Steben, and which is yet only 340 toises long, in the *transition slate* have successively been found subordinate strata of pure and porphyritic *gruenstein,* strata of lydian stone and ampelite (*alaunschiefer*), and strata of fine grained gruenstein. All these strata characterize the transition slates.

† For instance at the Glyshorn, at the Col de Balme, &c.

North of the ravine of *Piedras Azules*. I did not see there any pyroxene; but on the very spot I recognised a number of crystals in the *amygdaloid*, which appears so strongly linked to the *gruenstein*, that they alternate several times.

The geognost may consider his task as fulfilled, when he has traced with accuracy the positions of the divers strata; and has pointed out the analogies, which these positions display, with what has been observed in other countries. But how can he avoid being tempted to ascend to the origin of so many different substances, and to inquire how far the dominion of fire has extended in the mountains, that bound the great basin of the steppes? In researches on the position of rocks, we have generally to complain of not sufficiently perceiving the connexion between the masses, which we believe to be superimposed on one another. Here the difficulty seems to arise from the too intimate and too numerous relations displayed by rocks, that are thought not to belong to the same family.

The *phonolite* (or *leucostine compacte* of Mr. Cordier) is pretty generally regarded by all, who have at once examined burning and extinguished volcanoes, as a flow of lithoid lava. I found no real basaltes, or dolerites; but the presence of pyroxene in the *amygdaloid* of Parapara leaves little doubt of the igneous origin of those spheroidal masses, fissured, and full of cavities. Balls of this amygdaloid are enchased in the *gruenstein*; and this *gruenstein* alternates on one side with a *green slate*, on the other with the *serpentine* of Tucutunemo. Here then is a connexion sufficiently intimate established between the phonolites and the green slates, between the pyroxenic amygdaloids and the serpentines containing copper ores, between volcanic substances and others that are included under the vague names of *transition traps*. All these masses are destitute of quartz like the real trap-porphyries, or volcanic *trachytes*. This phenomenon is the more remarkable, as the *gruensteins*, which are called primitive, almost always contain quartz in Europe. The most general dip of the slates of *Piedras Azules*, of the gruensteins of Parapara, and of the pyroxenic amygdaloids imbedded in strata of gruenstein, do not follow the slope of the ground from North to South, but is pretty regularly toward the North. The strata *fall* toward the chain of the coast, as substances that had not been in fusion would do. Can we admit, that so many alternating rocks, imbedded one in the other, have a common origin? The nature of the phonolites, which are lithoid lavas with a feld-spar basis, and the nature of the green slates mingled with hornblende, oppose this opinion. In this state of things we may choose between two solutions of the problem in question. In one of these solutions, the phonolite of the *Cerro de Flores* is to be regarded as the sole volcanic production of the tract; and we are forced to unite the pyroxenic amygdaloids with the rest of the gruensteins in one single formation, that which is so common in the transition mountains of Europe, considered hitherto as not volcanic. In the other solution of the problem, the masses of phonolite, amygdaloid, and *gruenstein*, which are found to the South of the ravine of Piedras Azules, are separated from the *gruensteins* and serpentine rocks, that cover the declivity of the mountains North of the ravine. In the present state of knowledge, I find difficulties almost equally great, in adopting either of these suppositions: but I have no doubt, that, when the real gruensteins (not the hornblende gruensteins) contained in the gneiss and mica-slates, shall have been more attentively examined in other places; when the basaltes (with pyroxene), forming strata in primitive rocks *, and the diabases and amygdaloids in the transition mountains, shall have been carefully studied; when the texture of the masses shall have been subjected to a kind of mechanical analysis, and the hornblendes better distinguished from the pyroxenes*, and the gruensteins from the dolerites; a great number of phenomena, which now appear solitary and obscure, will be ranged, as it were of themselves, under general laws. The phonolites and other rocks of igneous origin at Parapara are so much the more interesting, as they indicate ancient eruptions in a *granitic zone;* as they belong to the shore of the basin of the steppes, as the basaltes of Harusch belong to the shore of the desert of Sahara †; and lastly as they are the only rocks of the kind we observed in the mountains of the Capitania General of Caraccas, which are also destitute of trachytes, or trap porphyry, basaltes, and volcanic productions ‡.

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* For instance, at Krobsdorf in Silesia, a stratum of basaltes has been recognized in the mica-slate by two celebrated geognosts, Messrs. von Buch and Raumer. (*Vom Granit des Riesengebirges*, 1813, p. 70.)

The southern declivity of the chain of the West is pretty steep; the steppes, according to my barometrical measurements, being a thousand feet lower than the bottom of the basin of Aragua. From the extensive table-land of the

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* The gruensteins or diabases of the Fichtelgebirge in Franconia, which belong to the transition slate, sometimes contain pyroxenes. See *Goldfuss und Bischof ueber das Fichtelgebirge, vol. i, p,* 172—174.

† *Hornemann, Voyage en Afrique*, vol. i, p. 81, and the excellent Geography of Mr. Ritter, vol. i, p. 372.

‡ From the Rio Negro to the coasts of Cumana and Caraccas, to the East of the mountains of Merida, which we did not visit.

Villa de Cura we descended toward the banks of the Rio Tucutunemo, which has hollowed itself out in a serpentine rock a *longitudinal* valley directed from East to West, at nearly the same level as La Victoria. A *transverse valley*, lying generally North and South, led us thence into the Llanos, by the villages of Parapara and Ortiz. It grows very narrow in several parts. Basins, the bottom of which is perfectly horizontal, communicate together by narrow passes with steep declivities. They were no doubt formerly small lakes, which by the accumulation of the waters, or by some more violent catastrophe, broke down the dykes, by which they were separated. This phenomenon is found in both continents, wherever the longitudinal valleys are examined, that form the *passages* of the Andes, the Alps *, or the Pyrennees. It is probable, that the irruption of the waters toward the Llanos have given by extraordinary rents the form of ruins to the *Morros* of San Juan and of San Sebastian. The volcanic tract of Parapara and Ortiz is now only 30 or 40 toises above the Llanos. The eruptions consequently took place at the lowest point of the granitic chain.

In the *Mesa de Paja*, in the 9th degree of latitude, we entered the basin of the Llanos. The

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* I remind travellers of the road from the valley of Ursern to the hospice of St. Gothard, and thence to Airolo.

Sun was almost at the zenith; the earth, wherever it appeared sterile and destitute of vegetation, was at the temperature of 48° or 50° *. Not a breath of air was felt at the height at which we were on our mules; yet, in the midst of this apparent calm, whirls of dust incessantly arose, driven on by those small currents of air, that glide only over the surface of the ground, and are occasioned by the difference of temperature, which the naked sand and the spots covered with herbs acquire. These *sand winds* augment the suffocating heat of the air. Every grain of quartz, hotter than the surrounding air, radiates heat in every direction; and it is difficult to observe the temperature of the atmosphere, without these particles of sand striking against the bulb of the thermometer. All around us, the plains seemed to ascend toward the sky, and that vast and profound solitude appeared to our eyes like an ocean covered with seaweeds. According to the unequal mass of vapours diffused through the atmosphere, and the variable decrement in the temperature of the different strata of air, the horizon in some parts was clear and distinct; in other parts it appeared undulating, sinuous, and as if striped. The earth there was confounded with the sky.

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* Reaumur's thermometer, buried in the sand, rose to 38·4° and 40°.

Through the dry fog, and strata of vapour, the trunks of palm-trees were seen from afar. Stripped of their foliage, and their verdant summits, these trunks appeared like the masts of a ship discovered at the horizon.

There is something awful, but sad and gloomy, in the uniform aspect of these Steppes. Every thing seems motionless; scarcely does a small cloud, as it passes across the zenith, and announces the approach of the rainy season, sometimes cast it's shadow on the savannah. I know not whether the first aspect of the Llanos excite less astonishment than that of the chain of the Andes. Mountainous countries, whatever may be the absolute elevation of the highest summits, have an analogous physiognomy; but we accustom ourselves with difficulty to the view of the Llanos of Venezuela and Casanare, to that of the *Pampas* of Buenos-Ayres and of Chaco, which recall to mind incessantly, and during journeys of twenty or thirty days, the smooth surface of the ocean. I had seen the plains or Llanos of La Mancha in Spain, and the heaths *(ericeta)* that extend from the extremity of Jutland through Luneburg and Westphalia * to Belgium. These last are real Steppes, of which man during several ages has been able to subject only some small portions to cultivation; but the plains of the West and North of Europe present a feeble image of the immense Llanos of South America. It is in the South-East of our continent, in Hungary between the Danube and the Theiss; in Russia, between the Borysthenes the Don, and the Wolga, that we find those vast pastures, which seem to have been levelled by a long abode of the waters, and terminate the horizon on every side. The plains of Hungary, where I traversed them, on the frontiers of Germany, between Presburg and Œdenburg, strike the imagination of the traveller by the constant display of the *mirage*, or extraordinary refractions; but their greatest extent is more to the East, between Czegled, Debreczin, and Tittel *, which has only two outlets, one near Gran and Waitzen; the other between Belgrade and Widdin.

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* The smoothest parts of these heaths *(Heideland)* are found between Oldenbourg and Osnabruck, near Frisoyde.

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* These vast steppes of Hungary are elevated only thirty or forty toises above the level of the sea, which is more than eighty leagues distant from them. (Wahlenberg, Flora Carpath., p. 32.) Baron Podmanitzky, highly distinguished for his knowledge of the physical sciences, caused the level of these plains to be taken, on account of a canal projected between the Danube and the Theiss. He found the *line of division*, or the convexity of the ground, which slopes on each side toward the beds of the two rivers, thirteen toises above the height of the Danube. Several leagues square are destitute of villages and farms. Those pastures, which constitute the horizon, are called in the country *Puszta*. These plains, intermingled with marshes and sandy tracts, are found on this side of the Theiss between Czegled, Csaba, Komloss, and Szarwass; beyond the Theiss, between Debreczin, Karczag,

The different parts of the world have been supposed to be characterized by saying, that Europe has it's *heaths*, Asia it's *steppes*, Africa it's *deserts*, and America it's *savannahs*; but by this distinction contrasts are established, that are not founded either on the nature of things, or the genius of languages. The existence of a heath always supposes an association of plants of the family of *ericæ*; the steppes of Asia are not every where covered with saline plants; the savannahs of Venezuela furnish not only the gramina, but with them small herbaceous mimosas, legumina, and other dicotyledonous plants. The plains of Songaria, those which extend between the Don and the Volga, and the *Puszta*, of Hungary, are real savannahs, pasturages abounding in grasses; while the savannahs to the East and West of the Stony Mountains and of New Mexico produce chenopodiums, containing carbonat and muriat of soda *. Asia has real deserts, destitute of vegetation, in Arabia, in Gobi, and in Persia. Since

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and Szoboszlo. I calculated, according to the map of Lipsky, the area of these plains of the *interior basin* of Hungary to be two thousand five hundred or three thousand square leagues, of twenty to a degree. Between Czegled, Szolnok, and Ketskemet, the plain is almost a sea of sand.

* North-West of the Missoury, and North of the Rio Zaguananas, which flows into the Rio Colorado of California

we have become better acquainted with the deserts in the interior of Africa, so long and so vaguely confounded together under the name of desert of Sahara *(Zahra)*; it has been observed, that in this continent, toward the East, savannahs and pastures are found, as in Arabia, set in the midst of naked, and barren tracts. It is these last, these deserts covered with gravel, and destitute of plants, that are almost entirely wanting in the New World. I saw them only in the low part of Peru, between Amotape and Coquimbo, on the borders of the South-Sea. These are called by the Spaniards not *Llanos*, but the *Desiertos* of Sechura and Atacamez. This solitary tract is not broad, but four hundred and forty leagues long. The rock pierces every where through the quicksands. No drop of rain ever falls on it; and, like the desert of Sahara, to the North of Tombuctoo, the Peruvian desert affords, near Huaura, a rich mine of native salt. Every where else, in the New World, there are plains, desert because not inhabited, but no real deserts *.

The same phenomena are repeated in the most

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the plains contain gypsum and sal gem. See my Mexican Atlas, Pl. 1.

* We are almost tempted, however, to call that vast and sandy table-land of Brazil, the *Campos dos Parecis*, which gives birth to the rivers Tapajos, Paraguay, and Madeira, and which reaches the summit of the highest mountains, a desert. Almost destitute of vegetation, it reminds us of *Gobi* in Mungolia.

distant regions; and, instead of designating those vast plains destitute of trees by the nature of the plants they produce, it seems natural to distinguish them into *deserts*, and *steppes* or *savannahs;* into bare lands without any appearance of vegetation, and lands covered with gramina or small plants of the dicotyledonous tribe. The savannahs of America, especially those of the temperate zone, have in many works been designated by the name of *prairies* *: but this term appears to me little applicable to pastures, that are often very dry, though covered with grass of four or five feet in height. The *Llanos* and the *Pampos* of South America are real steppes. They display a beautiful verdure in the rainy season, but in the time of great drought assume the aspect of a desert. The grass is then reduced to powder; the earth cracks; the alligator and the great serpents remain buried in the dried mud, till awakened from their long lethargy by the first showers of spring. These phenomena are observed on barren tracts of fifty or sixty leagues in length, wherever the savannahs are not traversed by rivers; for on the borders of rivulets, and around little pools of stagnant water, the traveller finds at certain distances, even during the period of the great droughts, thickets of mauritia, a palm, the leaves of which, spread out like a fan, preserve a brilliant verdure.

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* The French word for *meadows*. ED.

The steppes of Asia are all beyond the tropics, and form very elevated table-lands. America also displays savannahs of considerable extent on the backs of the mountains of Mexico, Peru, and Quito; but it's most extensive steppes, the Llanos of Cumana, Caraccas, and Meta, are little raised above the level of the ocean, and all belong to the Equinoctial zone. These circumstances give them a peculiar character. They have not, like the steppes of southern Asia, and the deserts of Persia, those lakes without issue, those small systems of rivers, that lose themselves either in the sands, or by subterraneous filtrations. The Llanos of America are inclined toward the East and South; and their running waters are branches of the Oroonoko.

The course of these rivers had once led me to believe, that the plains formed table-lands, raised at least from one hundred to one hundred and fifty toises above the level of the ocean. I supposed, that the deserts of interior Africa were also at a considerable height; and that they rose one above another like stages, from the coast to the interior of the continent. No barometer has yet been carried into the Sahara. With respect to the Llanos of America, I found by barometric heights observed at Calabozo, at the Villa del Pao, and at the mouth of the Meta, that their height is only forty or fifty toises above the level of the sea. The fall of the rivers is extremely gentle, often nearly imperceptible: and therefore the least wind, or the swelling of the Oroonoko, causes a reflux in those rivers that flow into it. The Indians believe they descend during a whole day in navigating from their mouths toward their sources. The waters that descend are separated from those that flow back by a great body of stagnant water, in which, the equilibrium being disturbed, whirlpools are formed, that are dangerous for boats.

The chief characteristic of the savannahs or steppes of South America is the absolute want of hills and inequalities, the perfect level of every part of the soil. Accordingly the Spanish conquerors, who first penetrated from Coro to the banks of the Apure, did not call them deserts, or savannahs, or meadows, but plains, *Llanos*. Often in a space of thirty square leagues there is not an eminence of a foot high. This resemblance to the surface of the sea strikes the imagination most powerfully, where the plains are altogether destitute of palm-trees; and where the mountains of the shore and of the Oroonoko are so distant, that they cannot be seen, as in the *Mesa de Pavones*. A person would be tempted there, to take the altitnde of the Sun with a quadrant, if the *horizon of the land* were not constantly misty, on account of the variable display of refraction. This equality of surface is still more perfect in the meridian of Calabozo, than toward the East, between the Cari, La Villa del Pao, and Nueva Barcelona; but it reigns without interruption from the mouths of the Oroonoko to La Villa de Araure and Ospinos, under a parallel of a hundred and eighty leagues in length; and from San Carlos to the savannahs of Caqueta, on a *meridian* of two hundred leagues *. It particularly characterizes the new continent, as it does the low steppes of Asia, between the Borysthenes and the Wolga, between the Irtisch and the Obi †. The deserts of central Africa, of Arabia, Syria, and Persia, Cobi, and Casna ‡, present on the contrary many inequalities, ranges of hills, ravines without water, and rocks that pierce the sands §.

The Llanos, however, notwithstanding the apparent uniformity of their surface, furnish two kinds of inequalities, that do not escape the observation of an attentive traveller. The first is known by the name of *Bancos:* they are real shoals in the basin of the steppes, fractured strata of sandstone, or compact limestone, standing four or five feet higher than the rest of the plain. These *banks* are sometimes three or four leagues in length; they are entirely smooth, with a horizontal surface; their existence is perceived only by examining their borders. The second species of inequality can be recognized only by geodesical or barometric levellings, or by the course of rivers. It is called *Mesa*, and is composed of small flats, or rather convex eminences, that rise insensibly to the height of a few toises. Such are toward the East, in the province of Cumana, on the North of the Villa de la Merced and Candelaria, the *Mesas of Amana*, of *Guanipa*, and of *Jonoro*, the direction of which is South-West and North-East; and which, in spite of their inconsiderable elevation, divide the waters between the Oroonoko and the northern coast of Terra Firma. The convexity of the savannah alone occasions this partition: we there find the *divortia aquarum* * as in Poland, where, far from the Carpathian mountains, the plain itself divides the waters between the Baltic and the Black Sea. Geographers, who suppose that there exists a chain of mountains wherever there is a line of division, have not failed to mark one in the maps, at the sources of the Rio Neveri, the Unare, the Guarapiche, and the Pao. Thus the priests of Mongul race, according to ancient and superstitious custom, erect *oboes*, or little mounds of stone on every point where the rivers flow in an opposite direction.

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* In strictness from N. N. E. to S. S. W.

† *Gueldenstedt Reise*, vol. i, p. 116—126. *Gmelin, Flor. Sibir. Præf.* p. 31. *Pallas*, vol. ii, p. 75; vol. iii, p. 638.

‡ Or Karak, between the Iaxartes and the Oxus.

§ See the laborious investigations of Mr. Meiners on Deserts, in the *Untersuchungen ueber die Menschenarten*, vol. i, p. 101.

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* "Cn. Manlium prope jugis (Tauri) ad divortia aquarum castra posuisse." Livy, lib. 38, c. 75 (*Ed. Venet.* vol. iv, p. 191.).

The uniform landscape of the Llanos; the extreme rarity of inhabitants; the fatigue of travelling beneath a burning sky, and an atmosphere darkened by dust; the view of that horizon, which seems for ever to fly before us; those lonely trunks of palm-trees, which have all the same aspect, and which we despair of reaching, because they are confounded with other trunks, that rise by degrees on the visual horizon; all these causes combined make the steppes appear far greater than they are in reality. The planters who inhabit the southern declivity of the chain of the coast see the steppes extend toward the South, as far as the eye can reach, like an ocean of verdure. They know, that from the Delta of the Oroonoko to the province of Varinas, and thence, by traversing the banks of the Meta, the Guaviare, and the Caguan, they can advance three hundred and eighty leagues* in the plains, first from East to West, and then from North-East to South-East beyond the Equator, to the foot of the Andes of Pasto. They know by the accounts of travellers the Pampas of Buenos

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* This is the distance from Tombuctoo to the northern coast of Africa.

Ayres, which are also Llanos covered with fine grass, destitute of trees, and filled with oxen and horses become wild. They suppose, according to the greater part of our maps of America, that this continent has only one chain of mountains, that of the Andes, which stretches from South to North; and they form a vague idea of the contiguity of all the plains from the Oroonoko and the Apure to the Rio de la Plata and the Straits of Magellan.

I shall not stop here to give a mineralogical description of the *transverse chains*, which divide America from East to West, and which I made known in the year 1800 in my *Sketch of a Geological View**. It will be sufficient to notice in the most clear and concise manner the general structure of a continent, the extremities of which, though placed in climates little analogous, yet afford several features of resemblance. In order to have an exact idea of the plains, their configuration, and their limits, we must know the chains of mountains, that form their boundary. We have already described the *Cordillera of the coast*, of which the highest summit is the Silla de Caraccas, and which is linked by the Paramo de las Rosas to the Nevado de Merida, and the Andes of New Grenada. We have seen, that, in the tenth degree of North latitude, it stretches from Quibor and Barquesimeto as far as the point of Paria. A second chain of mountains, or rather a less elevated but much larger group, extends between the parallels of 3° and 7° from the mouths of the Guaviare and the Meta to the sources of the Oroonoko, the Marony, and the Esquibo, toward French and Dutch Guyana. I call this chain *the Cordillera of Parime*, or of the great cataracts of the Oroonoko. It may be followed for a length of two hundred and fifty leagues; but it is less a chain, than a collection of granitic mountains, separated by small plains, without being every where disposed in lines. The group of the mountains of Parime narrows considerably between the sources of the Oroonoko and the mountains of Demerary, in the Sierras of Quimiropaca and Pacaraimo, which divide the waters between the Carony and the Rio Parime, or Rio de Aguas Blancas. This is the theatre of the expeditions undertaken in search of El Dorado, and the great city of Manoa, the Tombuctoo of the New Continent. The Cordillera of Parime is not connected to the Andes of

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* *Esquisse d'un Tableau Géologique, Journal de Physique*, vol. liii, p. 30. This paper had been written and sent to Europe immediately after my return from the Oroonoko, when I had scarcely had time to calculate the astronomical observations, by which I determined the configuration of the chain of La Parime. I have since rectified those first notions of the extent of the plains, by the help of ideas which I acquired during my stay in Peru, and by my connections with Brazil.

New Grenada, but is separated from these by a space eighty leagues broad. If we suppose it to have been destroyed in this space by some great revolution of the globe, which is scarcely probable, we must admit, that it anciently branched off from the Andes between Santa Fe de Bogota and Pamplona. This remark serves to fix more easily in the memory of the reader the geographical position of a Cordillera, till now very imperfectly known. A third chain of mountains unites in 16° and 18° of South latitude (by Santa Cruz de la Sierra, the Serranias of Aguapehy, and the famous *Campos dos Parecis)* the Andes of Peru to the mountains of Brazil. It is the *Cordillera of Chiquitos* that widens in the Capitania de Minas Geraes, and divides the rivers flowing into the Amazon from those of the Rio de la Plata *, not only in the interior of the country, in the meridian of Villa Boa, but also at a few leagues from the coast, between Rio Janeiro and Bahia †.

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* There is only a carrying place of 5,322 *bracas* between the Guapore (a branch of the Marmore and of the Madeira) and the Rio Aguapehy (a branch of the Jaura and of the Paraguay). See the instructive Journal published at Rio Janeiro under the name of *Patriota*, 1813, N° 5, p. 83.

† The Cordillera of Chiquitos and of Brazil stretches toward the South-East, in the government of the Rio Grande, beyond the latitude of 30° South.

These three transverse chains, or rather *these three groups of mountains* stretching from West to East, within the limits of the torrid zone, are separated by tracts entirely level, *the plains of Caraccas*, or of the *Lower Oroonoko*; the *plains of the Amazon* and the Rio Negro; and the plains of *Buenos Ayres*, or of La Plata. I do not use the name of valley, because the Lower Oroonoko and the Amazon, far from flowing in a valley, form but a little furrow in the midst of a vast plain. The two basins, placed at the extremities of South America, are savannahs or steppes, pasturage without trees; the intermediate basin, which receives the equatorial rains during the whole year, is almost entirely one vast forest, in which no other road is known than the rivers. That strength of vegetation, which conceals the soil, renders also the uniformity of it's level less perceptible; and *the plains* of Caraccas and La Plata alone bear this name. The three basins we have just decribed are called, in the language of the colonists, the *Llanos* of Varinas and of Caraccas, the *bosques* or *selvas* (forests) of the Amazon, and the *Pampas* of Buenos Ayres. The trees not only for the most part cover the plains of the Amazon, from the Cordillera of Chiquitos, as far as that of Parime; they crown also these two chains of mountains, which rarely attain the height of the Pyrennees [*]. On this account, the vast plains of the Amazon, the Madeira, and the Rio Negro, are not so distinctly bounded as the *Llanos* of Caraccas, and the *Pampas* of Buenos Ayres. As the region of forests comprises at once the plains and the mountains, it extends from 18° South [†] to 7° and 8° North, and occupies an extent of near a hundred and twenty thousand square leagues. This forest of South America, for in fact there is only one, is six times larger than France. It is known to Europeans only on the shores of some rivers, by which it is traversed; and has it's openings, the extent of which is in proportion to that of the forest. We shall soon skirt the marshy savannahs, between the Upper Oroonoko, the Conorichite, and the Cassiquiare, in the latitude of 3° and 4°. There are other openings, or *sava-*

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[*] We must except the westernmost part of the Cordillera of Chiquitos, between Cochabamba and Santa Cruz de la Sierra, where the summits are covered with snow; but this colossal group almost still belongs to the Andes de la Paz, of which it forms a promontory or spur, directed toward the East.

[†] To the West, in consequence of the Llanos of Manso, and the Pampas de Huanacos, the forests do not extend generally beyond the parallels of 18° or 19° South latitude; but to the East, in Brazil (in the capitanias of St. Paul and Rio Grande), as well as in Paraguay, on the borders of the Parana, they advance as far as 25° South.

nas limpias[*] in the same parallel, between the sources of the Mao and the Rio de Aguas Blancas, to the South of the Sierra de Pacaraima. These last savannahs are inhabited by Caribbees, and nomade Macusis; they lie near the frontiers of Dutch and French Guyana.

Having just described the geological constitution of South America; we shall now mark it's principal features. The coasts of the West are bordered by an enormous wall of mountains, rich in precious metals, wherever the volcanic fire has not pierced through the eternal snows. This is the Cordillera of the Andes. Summits of trap porphyry rise beyond three thousand three hundred toises, and the *mean height of the chain*[†] is one thousand eight hundred and fifty toises. It stretches in the direction of a meridian, and sends into each hemisphere a lateral branch, in the latitudes of 10° North, and 16° and 18° South. The first of these branches, that of the coast of Caraccas, is not so wide, and forms a real chain. The

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glish feet.

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[*] Open savannahs, without trees, *limpias de arboles.*

[†] In New Grenada, Quito, and Peru, according to measurements taken by Bouguer, La Condamine, and myself. See, on the traces of resemblance displayed in the Pyrennees, the Alps, the Andes, and Himalaya, in their highest summits, and the mean elevation of the chain (two particulars so often confounded), my researches on the mountains of India. (*Ann. de Chimie et de Physique,* 1816, t. iii, p. 310.)

second, the Cordillera of Chiquitos and of the sources of the Guapore, is very rich in gold, and widens toward the East, in Brazil, into vast table-lands, of a mild and temperate climate. Between these two transverse chains contiguous to the Andes, an isolated group of granitic mountains is found, from 3° to 7° of North latitude; which runs equally in a direction parallel to the Equator, but, not passing the meridian of 71°[*], terminates abruptly toward the West, and is not united to the Andes of New Grenada. These three transverse chains have no active volcanoes; we are ignorant whether the southernmost, like the two others, be destitute of trachytes or trap porphyry. None of their summits enter the limit of perpetual snows; and the *mean height* of the Cordillera of La Parime, and of the littoral chain of Caraccas, does not reach six hundred toises, though some summits rise fourteen hundred toises above the level of the sea[†]. The three transverse chains are separated by plains entirely closed toward the West, and open toward the East and South-East. When we reflect on their small elevations above the surface of the ocean, we are tempted to consider them as gulfs stretching in the direction of the current of rotation. If, from the effect of some peculiar attraction, the waters of the Atlantic were to rise fifty toises at the mouth of the Oroonoko, and two hundred toises at the mouth of the Amazon, *the great tide* would cover more than half of South America. The eastern declivity, or the foot of the Andes, now six hundred leagues distant from the coast of Brazil, would become a shore beaten by the waves. This consideration is the result of a barometric measurement, taken in the province of Jaen de Bracamoros, where the Amazon issues out from the Cordilleras. I found the *mean* height of this immense river* only a hundred and ninety-four toises above the present level of the Atlantic. The intermediate plains however, covered with forests, are still five times higher than the *Pampas* of Buenos Ayres, and the *Llanos* of Caraccas and the Meta, covered with gramina.

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[*] The longitude of Porto-Cabello is 70° 37′ 3″ West of Paris.

[†] We do not reckon here, as belonging to the chain of the coast, the Nevados and Paramos of Merida and of Truxillo, which are a prolongation of the Andes of New Grenada. The chain of Caraccas begins only to the East of 71° of longitude.

Those Llanos, which form the basin of the Oroonoko, and which we crossed twice in one year, in the months of March and July, communicate with the basin of the Amazon and the Rio Negro, bounded on one side by the Cordillera of Chiquitos, and on the other by the mountains of Parime. The opening, which remains between these last and the Andes of New Grenada, occasions this communication. The aspect of the land here reminds us, but on a much larger scale, of the plains of Lombardy, which also are raised only fifty or sixty toises above the level of the ocean *; and are directed first, from La Brenta to Turin, East and West; and then, from Turin to Coni, North and South. If we were authorized from other geological facts, to regard the three great plains of the Lower Oronooko, the Amazon, and the Rio de la Plata, as the basins of ancient lakes †, we should imagine we perceived in the plains of

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* In the latitude of 5° 31′ 28″ South, and longitude 80° 56′ 37″ West.

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* Mr. Oriani found the surface of the botanical garden of the college of Brera, at Milan, only 65·7 toises, and that of the great square of Pavia only 43·5 above the coasts. But the level of lake Maggiore, on the northern side of the plain, is 106 toises high; and Turin (at the hall of the Academy), at the western extremity of the plain, is, according to Mr. Ducros, 126 toises above the level of the Adriatic.

† In Siberia the great steppes between the Irtisch and the Oby, especially that of Baraba, full of salt lakes (Tchabakly, Tchany, Karasouk, and Topolnoy), appear to have been, according to the Chinese traditions, even within historical times, an inland sea. See the learned researches of *Mr. Julius von Klaproth, Mag. Encyclopédique, Septembre* 1817, p. 134.

the Rio Vichada and the Meta a channel, by which the waters of the superior lake, those of the plains of the Amazon, forced their way toward the inferior basin, that of the Llanos o Caraccas, separating the Cordillera of La Parime from that of the Andes. This channel is a kind of land-strait *. The ground, perfectly level, between the Guaviare, the Meta, and the Apure, displays no vestige of a violent irruption of the waters; but on the edge of the Cordillera of Parime, between the latitudes of 4° and 7°, the Oroonoko, which flows in a western direction from it's source to the mouth of the Guaviare, has forced it's way through the rocks, directing it's course from South to North. All the great cataracts, as we shall soon see, are placed in this interval. When the river has reached the mouth of the Apure in that very low ground, where the slope toward the North is met by the counterslope toward the South-East, that is to say, by the *talus* of the plains, which rise imperceptibly toward the mountains of Caraccas, the river turns anew, and flows toward the East. It appeared to me, that it was proper already to fix the attention of the reader on these singular inflexions of the Oroonoko, because, belonging at once to two basins, it's course marks in some sort, even on the most imperfect maps, the direction of that part of the plains, which are interposed between New Grenada, and the western border of the mountains of Parime.

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* *Andreossy, Voyage à l'Embouchure de la Mer-Noire,* 1818, p. 27, 34, and 311.

The *Llanos* or steppes of the Lower Oroonoko and of the Meta, like the deserts of Africa, bear different names in different parts. From the mouths of the Dragon, the *Llanos* of Cumana, of Barcelona, and of Caraccas or Venezuela *, follow from East to West. Where the steppes turn toward the South and the South-South-West, from the latitude of 8°, between the meridians of 70° and 73°, we find, from North to South, the Llanos of Varinas, Casanare, the Meta, Guaviare, Caguan, and Caqueta †. The plains of Varinas afford some feeble monuments of the industry of a nation, that has disappeared. Between Mijagual and the Cano de la Hacha, we find some real *tumuli*, called in the country the *Serillos de los Indios*. They are hillocks in the shape of cones, formed of earth by the hands of men, and probably contain bones, like the *tumuli* in the steppes of Asia. A fine road is also discovered near Hato de la Calzada, between Varinas and Canagua, five leagues long, made before the conquest, in the most remote times, by the natives. It is a causeway of earth fifteen feet high, crossing a plain often overflowed*. Did nations farther advanced in civilization descend from the mountains of Truxillo and Merida toward the plains of the Rio Apure? The Indians, whom we now find between this river and the Meta, are in too rude a state, to think of making roads or raising *tumuli*.

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* The following are *subdivisions* of these three great *Llanos*, as I marked them down on the spot. The *Llanos* of Cumana and New Andalusia include those of Maturin and Terecen, of Amana, Guanipa, Jonoro, and Cari. The *Llanos* of Nueva Barcelona comprise those of Aragua, Pariaguan, and Villa del Pao. We distinguish in the *Llanos* of Caraccas those of Chaguaramas, Urituco, Calabozo or Guarico, La Portuguesa, San Carlos, and Araure.

† The inhabitants of these plains distinguish as *subdivisions*, from the Rio Portuguesa to Caqueta, the *Llanos* of Guanare, Bocono, Nutrias or the Apure, Palmerito near Quintero, Guardalito and Arauca, the Meta, Apiay near the port of Pachaquiaro, Vichada, Guaviare, Arriari, Inirida, the Rio Hacha, and Caguan. The limits between the savannahs and the forests, in the plains that extend from the sources of the Rio Negro to Putumayo, are not sufficiently known.

I calculated the area of these Llanos from the Caqueta to the Apure, and from the Apure to the Delta of the Oroonoko, and found it seventeen thousand square leagues of twenty to a degree. The part running from North to South is almost double that which stretches from East to West, between the Lower Oroonoko and the littoral chain of Caraccas. The

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* *Viage de Varinas a Santa-Fe*, by Mr. Palacios. (MS.)

Pampas on the North and North-West of Buenos Ayres, between this city and Cordova, Jujuy, and the Tucuman, are of nearly the same extent as the Llanos; but the *Pampas* stretch still farther on for the length of 18° toward the South; and the land they occupy is so vast, that they produce palm-trees at one of their extremities, while the other, equally low and level, is covered with eternal frost.

The Llanos of America, where they extend in the direction of a parallel to the equator, are four times narrower than the great desert of Africa. This circumstance is very important in a region, where the winds constantly blow from East to West. The farther the plains stretch in this direction, the more ardent is their climate. The great ocean of sand in Africa communicates by Yemen * with Gedrosia and Beelochistan, as far as the right bank of the Indus; and it is from the effect of winds, that have passed over the deserts situate to the East, that the little basin of the Red Sea, surrounded by plains, which send forth from all sides radiant caloric, is one of the hottest regions of the Globe. The unfortunate Captain Tuckey * relates, that the centigrade thermometer keeps there generally in the night at 34°, and by day from 40° to 44°. We shall soon see, that even in the westernmost part of the steppes of Caraccas, we seldom found the temperature of the air, in the shade, and remote from the Sun, above 37°.

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* We cannot be surprised, that the Arabic should be richer than any other language of the East in words expressing the ideas of desert, uninhabited plains, and plains covered with gramina. I could give a list of thirty-five of these words, which the Arabian authors employ, without always distiuguishing them by the gradations, that each separate word expresses. *Makadd* and *kaâh* indicate in preference, plains; *bakaah*, a table-land; *kafr*, *mikfar*, *smlis*, *mahk*, and *habaucer*, a naked desert, covered with sand and gravel; *tanufah*, a steppe. *Zahra* means at once a naked desert and a savannah. The word *steppe*, or *step*, is Russian, and not Tatarian. In the Turco-tatar dialect, a heath is called *tala* or *tschol*. The word *gubi*, of which Europeans

These physical considerations on the steppes of the New World are linked with others, more highly interesting because they are connected with the history of our species. The great sea of sand in Africa, the deserts without water, are frequented only by caravans, that take fifty days to traverse them †. Separating the nations of Negro race from those of the Moorish and Beriber ‡ the Sahara is inhabited only in the Oases.

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have made by corruption *cobi*, signifies in the Mungal tongue a naked desert. It is equivalent to the *scha-mo* or *khan-hai* of the Chinese. A *steppe*, or plain covered with herbs, is in Mungal, *kudah*; in Chinese, *kouang*.

* Exped. to explore the River Zaira, 1818, Introd. p. li.

† This is the *maximum* of the time, according to Major Rennell (Travels of Mungo Park, vol. ii, p. 335).

‡ The Shilha, and the Kabyles.

It affords pasturage only in the eastern part, where, from the effect of the trade-winds, the layer of sand is less thick, so that the springs can appear at the surface of the earth. In America, the steppes, less vast, less scorching, fertilized by fine rivers, present fewer obstacles to the intercourse of nations. The Llanos separate the chain of the coast of Caraccas and of the Andes of New Grenada from the region of forests; from that *Hylæa* * of the Oroonoko, which, from the first discovery of America, has been inhabited by nations more rude, and farther removed from civilization, than the inhabitants of the coast, and still more than the mountaineers of the Cordilleras. The steppes however were no more heretofore the rampart of civilization, than they are now the rampart of the liberty of the hordes that live in the forests. They have not hindered the nations of the Lower Oroonoko from going up the little rivers, and making incursions on the North and the West. If, according to the various distribution of animals on the Globe, the pastoral life could have existed in the New World; if, before the arrival of the Spaniards, the *Llanos* and the *Pampas* had been filled with those numerous herds of cows and horses, that graze there; Columbus would have found the human race in a state quite different. Pastoral nations, living on milk and cheese, real *nomades*, would have spread themselves over those vast plains, which communicate with each other. They would have been seen at the period of great droughts, and even at that of inundations, fighting for the possession of pastures; subjugating one another mutually; and, united by the common tie of manners, language, and worship, rise to that state of demicivilization, which we observe with surprise in the nations of the Mungal and Tatar race. America would then, like the centre of Asia, have had it's conquerors; who, ascending from the plains to the table-lands of the Cordilleras, and abandoning a wandering life, would have subdued the civilized nations of Peru and New Grenada; overturned the throne of the Incas, and of the Zaque *, and substituted for the despotism, which is the fruit of theocracy, that despotism which arises from the patriarchal government of a pastoral people. In the New World the human race has not experienced these great moral and political changes; because the steppes, though more fertile than those of Asia, have remained without herds; because none of the animals, that furnish milk in abundance, are natives of the plains of South

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* Ὑλαίη. *Herod. Melp.* (*Ed. Schweigh.*, vol. ii, p. 267.)

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* The *Zaque* was the secular chief of Cundinamarca. His power was shared with the high priest (*Lama*) of Iraca. See my *Recherches sur les Monuments des Americains* (ed. in folio, p. 246; and Eng. transl. vol ii, or xiv of the present work, p. 108—9).

America; and because, in the progressive unfolding of American civilization, the intermediate link is wanting, that connects the hunting with the agricultural nations.

I have thought proper to bring together these general notions on the plains of the new continent, and the contrast they exhibit with the deserts of Africa and the fertile steppes of Asia, in order to give some interest to the narrative of a journey across lands of so monotonous an aspect. Having now accomplished this task, I shall trace the road we followed from the volcanic mountains of Parapara, and the northern side of the Llanos, to the banks of the Apure in the province of Varinas.

After having passed two nights on horseback; and sought in vain by day for some shelter from the ardor of the Sun, beneath the tufts of the murichi palm-trees; we arrived before night at the little farm of the Alligator *(El Cayman)*, called also *La Guadalupe*. It was a *hato de ganado*, that is to say, a solitary house in the steppes, surrounded by a few small huts, covered with reeds and skins. The cattle, oxen, horses, and mules, are not penned, but wander freely over an extent of several square leagues. There is nowhere any enclosure; men naked to the waist, and armed with a lance, ride over the savannahs, to inspect the animals, bring back those that wander too far from the pastures of the farm, and mark with a hot iron all that do not already bear the mark of the proprietor. These Mulattoes, who are known by the name of *Peones Llaneros*, are partly freed men and partly slaves. There does not exist a race more constantly exposed to the devouring heat of the tropical Sun. Their food is meat dried in the air, and a little salted; and of this even their horses sometimes eat. Always in the saddle, they fancy they cannot make the slightest excursion on foot. We found an old Negro slave, who governed the farm in the absence of his master. He told us of herds composed of several thousand cows, that were grazing in the steppes, yet we asked in vain for a bowl of milk. We were offered, in the shell of the tutumo, a yellow, muddy, and fetid water, drawn from a neighbouring pool. The indolence of the inhabitants of the Llanos is such, that they do not dig wells, though they know that almost every where at ten feet deep fine springs are found in a stratum of conglomerate, or red sand-stone. After having suffered one half of the year from the effect of inundations, they patiently expose themselves, during the other half, to the most painful want of water. The old Negro advised us, to cover the cup with a linen cloth, and drink as through a filter, that we might not be incommoded by the smell, and swallow less of the fine yellowish clay suspended in the water.

We did not then think, that we should afterward be forced during whole months to have recourse to this expedient. The waters of the Oroonoko are alike loaded with earthy particles; they are even fetid, where dead bodies of alligators are found in the creeks lying on banks of sand, or half-buried in the mud.

No sooner were our instruments unloaded, and safely placed, than our mules were set at liberty, to go, as they say here, "and search for water in the savannah *." There are little pools round the farm, which the animals find, guided by their instinct, by the view of some scattered tufts of mauritia, and by the sensation of humid coolness, caused by little currents of air amid an atmosphere, which to us appears calm and tranquil. When the pools of water are far distant, and the people of the farm are too lazy to lead the cattle to these natural watering-places, they confine them during five or six hours in a very hot stable, before they let them loose. Excess of thirst then augments their sagacity, sharpening as it were their senses and their instinct. No sooner is the stable opened, than you see the horses and mules, especially the latter, the penetration of which exceeds the intelligence of the horses, rush into the savannahs. Their tail raised, their head thrown back, they

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* *Para buscar agua.*

run against the wind, stopping from time to time as if they were exploring space; they follow less the impressions of sight than of smell; and at length announce by prolonged neighings, that there is water in the direction of their course. All these movements are executed more promptly, and with readier success, by horses born in the Llanos, and which have long enjoyed their liberty in wandering troops, than by those that come from the coast, and descend from domestic horses. In animals for the most part, as in man, the quickness of the senses is diminished by long subjection, and by the habits that arise from stability of abode, and the progress of cultivation.

We followed our mules in search of one of those pools, whence the muddy water was drawn, that had so ill quenched our thirst. We were covered with dust, and tanned by the sandy wind, which burns the skin still more than the rays of the Sun. We longed impatiently to take a bath, but we found only a great reservoir of feculent water, surrounded with palm-trees. The water was turbid, though, to our great astonishment, a little cooler than the air. Accustomed during our long journey to bathe whenever we had an opportunity, often several times in the same day, we hastened to plunge into the pool. We had scarcely begun to enjoy the coolness of the bath, when a noise, which we heard on the opposite bank, made us leave the water precipitately. It was an alligator plunging into the mud. It would have been imprudent, to pass the night in this marshy spot.

We were only at the distance of a quarter of a league from the farm, yet we continued walking more than an hour without reaching it. We perceived too late, that we had taken a false direction. Having left it at the decline of day, before the stars were visible, we had gone forward in the plain as by chance. We were, as usual, provided with a compass; and it was even easy for us to steer our course from the position of Canopus and the Southern Cross; but all these means became useless, because we were uncertain whether, on leaving the farm, we had gone toward the East or the South. We attempted to return to the spot where we had bathed, and we again walked three quarters of an hour, without finding the pool. We sometimes thought we saw fire at the horizon; but it was the stars that were rising, and of which the image was enlarged by the vapours. After having wandered a long time in the savannah, we resolved to seat ourselves beneath the trunk of a palm-tree, in a spot perfectly dry, surrounded by short grass; for the fear of water-serpents is always greater than that of jaguars in Europeans recently disembarked. We could not flatter ourselves, that our guides, of whom we knew the insuperable indolence, would come in search of us in the savannah before they had prepared their food, and finished their repast. In proportion to the uncertainty of our situation, we were agreeably affected by hearing from afar the sound of a horse advancing toward us. The rider was an Indian armed with a lance, who had just made the *rodeo*, or round, in order to collect the cattle within a determinate space of ground. The sight of two white men, who said they had lost their way, led him at first to suspect some trick. We found it difficult to inspire him with confidence; he at last consented to guide us to the farm of the *Cayman*, but without slackening the gentle trot of his horse. Our guides assured us, that "they had already begun to be uneasy about us:" and, to justify this inquietude, they gave a long enumeration of persons, who, having lost themselves in the Llanos, had been found nearly exhausted. It may be supposed, that the danger is imminent only to those, who lose themselves far from any habitation; or who, having been stripped by robbers, which has happened of late years, have been fastened by the body and hands to the trunk of a palm-tree.

In order to suffer less from the heat of the day, we set off at two in the morning, with the hope of reaching Calabozo before noon, a little but very commercial town, situate in the midst of the Llanos. The aspect of the country was still the same. There was no moonlight; but the great masses of nebulæ, that decorate the southern sky, enlighten, as they set, a part of the terrestrial horizon. The solemn spectacle of the starry vault, which displays itself in it's immense extent; the cool breeze which blows over the plain during the night; the waving motion of the grass, wherever it has attained any height; every thing recalled to our minds the surface of the ocean. The illusion above all augments, and we are never weary of telling it, when the disk of the Sun shows itself at the horizon, repeats it's image by the effects of refraction, and, soon losing it's flattened form, ascends rapidly and straight toward the zenith.

Sunrise too in the plains is the coolest moment of the day; but this change of temperature does not make a very lively impression on the organs. We did not find the thermometer in general sink below 27·5°[*]; while near Acapulco, at Mexico[†], in places equally low, the temperature at noon is often 32°, and at sunrise only 17° or 18°. The level surface of the ground in the Llanos, which, during the day, is never in the shade, absorbs so much heat, that, notwithstanding the nocturnal radiation toward a sky without clouds, the earth and air have not time to cool very sensibly from midnight to sunrise. At Calabozo *, the heat of the day, in the month of March, was from 31° to 32·5°; of the night, from 28° to 29°. The mean of this month, which is not the hottest in the year, appeared to be nearly 30·6°; which denotes an enormous heat for a country situate within the tropics, where the days are almost constantly of the same duration as the nights. The mean tem-

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[*] 22° Reaumur.

[†] On this extraordinary phenomenon, *consult* my *Essai Pol.*, vol. ii, p. 760.

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* At Calabozo, in the shade, and very far from the ground, or walls, on the 15th of March 1800, at 1^h Reaumur's therm. was 24·2°; the whale-bone hyg., 36°: at seven in the evening, th. 25°; hyg. 35·2°: at 12^h th. 23·2°; h. 35·4°. The 16th of March, at 17^h, th. 22·7°; h. 36°: at 23^h, th. 24·2°; h. 37°: at 0^h, th. 23·8°; h. 35°: at 2^h, th. 26°; h. 34·3°: at $4\frac{1}{2}^h$, th. 25·5°; h. 33·5°: at 7^h, th. 24·6°; h. 33·5°. The 17th of March, at 16^h, th. 26·3°; h. 34°: at 12^h, th. 22·4°; h. 35·3°. The 18th of March, at 23^h, th. 23·2°; h. 36°: till 11^h, at night, not a variation of 0·5° in the two instruments. I think that the climate of Calabozo is still hotter than that of Cumana. Having engaged Mr. Rubio, to make observations in this port during my absence, I am enabled to compare the same days. At Cumana Reaumur's therm. kept from the 15th to the 18th of March, from 7^h in the morning to 11 in the evening, between 20° and 24°. At Calabozo, 130 leagues distant from the eastern coasts, at the same hours, it was from 23° to 26°. At Cumana, the temperature of the month of March, 1800, was 22·2°; at Calabozo, nearly 24·5° Reaum.

perature of the hottest month at Cairo is only 29·9°; it is at Madras 31·8°; and at Abushar, in the Persian Gulf, where regular observations have been made, it is 34°; but the mean temperature of the whole year is lower at Madras, and at Abushar, than at Calabozo. Although a part of the Llanos is traversed, like the fertile steppes of Siberia, by little rivers, and banks extremely arid are surrounded by land that is inundated in the season of rains, the air is in general very dry. The hygrometer of Deluc* kept during the day at 34°, and by night at 36°.

In proportion as the Sun rose toward the zenith, and the earth and the strata of superincumbent air took different temperatures, the phenomenon of *mirage* displayed itself with it's numerous modifications. This phenomenon is so common under every zone, that I mention it only because we stopped to measure with some precision the breadth of the aërial interstice between the horizon and the suspended object. There was constantly suspension, *without inversion*. The little currents of air, that swept the surface of the soil, had so variable a temperature, that in a drove of wild oxen, one part appeared with the legs raised above the surface of the ground, while the other rested on it. The aërial interstice was, according to the distance of the animal, from three to four minutes. Where tufts of mauritia palm-trees were found united in long stripes, the extremities of these green stripes were suspended like the capes, which were for so long a time the object of my observations at Cumana *. A well-informed person assured us, that he had seen, between Calabozo and Uritueu, the image of an animal inverted, without there being any direct image. Niebuhr made a similar observation in Arabia. We several times thought we saw at the horizon the figures of *tumuli* and towers, that disappeared by intervals, without our being able to discern the real shape of the objects. They were perhaps hillocks, or small eminences, placed beyond the ordinary visual horizon. I shall not mention those tracts destitute of vegetation, which appear like large lakes with an undulating surface. This phenomenon, the most anciently observed, has occasioned the *mirage* to receive in Sanscrit the expressive name of *desire (thirst) of the antelope*. We admire the frequent allusions in the Indian, Persian, and Arabic poets, to the magical effects of terrestrial refraction. It was scarcely known to the Greeks and Romans. Proud of the riches of their soil, and the mild temperature of the air, they would have felt no envy of this poetry of the desert. It was born in Asia. The oriental poets found it's source in the nature of the country they inhabited; they were inspired by the aspect of those vast solitudes, interposed like arms of the sea or gulfs between lands adorned by nature with her most luxuriant fertility.

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* See above, ch. xv, p. 88 of this vol.

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* See vol iii, p. 542—554.

The plain assumes at sunrise a more animated aspect. The cattle, which had reposed during the night along the pools, or beneath clumps of *murichis* and rhopalas, were now assembled in herds; and these solitudes became peopled with horses, mules, and oxen, that live here, I will not say as wild, but as free animals, without settled habitations, and disdaining the care and the protection of man. In these hot climates, the oxen, though of Spanish breed, like those of the cold table-lands of Quito, are of a much gentler disposition. A traveller runs no risk of being attacked or pursued, as we were often in our excursions on the back of the Cordilleras, where the climate is rude, the aspect of the country more wild, and food less abundant. As we approached Calabozo, we saw herds of roebucks browzing peacefully in the midst of horses and oxen. They are called *matacani*; their flesh is good; they are a little larger than our roes, and resemble deer with a very sleek skin of a fawn-colour, and spotted with white. Their horns appeared to me with single *spears*. They had little fear of the presence of man; and in herds of thirty or forty we observed several, that were entirely white. This variety, common enough among the large stags of the cold climates of the Andes, surprised us in these low and burning plains. I have since learnt, that even the jaguar of the hot regions of Paraguay sometimes affords *albino* varieties, the skin of which is of so uniform a whiteness, that the spots or rings can be distinguished only in the sunshine. The number of *matacani*, or little deer[*], is so considerable in the Llanos, that a trade[†], might be carried on with their skins. A skilful hunter would kill more than twenty a day; but the indolence of the inhabitants is such, that often they will not give themselves the trouble of taking the skin. The same thing happens in the chace of the jaguars, or great American tigers, the skin of which fetches only one piastre in the steppes of Varinas, while at Cadiz it costs four or five.

The steppes that we traversed are principally covered with grasses of the genera killingia, cenchrus, and paspalum[‡]. At this season, near

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[*] *Venados de tierra caliente.*

[†] This trade is caried on, but on a very insignificant scale, at Carora and at Barquesimeto.

[‡] Kyllingia monocephala, k. odorata, cenchrus *pilosus*, vilfa tenacissima, andropogon *plumosus*, panicum *micranthum*, poa

Calabozo and St. Jerome del Pirital, these grasses scarcely attain the height of nine or ten inches. Near the banks of the Apure and the Portuguesa they rise to four feet in height, so that the jaguar can conceal himself among them, to spring upon the mules and horses that cross the plain. Mingled with these gramina some plants of the dicotyledonous class are found; as turneras, malvaceæ, and, what is very remarkable, little mimosas * with irritable leaves, called by the Spaniards *dormideras*. The same breed of cows, which fatten in Spain on sainfoin and clover, have found excellent nourishment in the herbaceous sensitive plants. The pastures where these sensitives particularly abound are sold dearer than others. To the East, in the *Llanos* of Cari and Barcelona, the cypura and the craniolaria †, the beautiful white flower of which is from six to eight inches long, rise solitarily amid the gramina. The pastures are richest not only around the rivers subject to inundations, but also wherever the trunks of palm-trees are nearer each other. The least fertile spots are those destitute of trees; and attempts to cultivate them would be nearly fruitless. We cannot at-

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reptans, paspalum *leptostachyum*, p. conjugatum, aristida *recurvata*. See our *Nov. Genera et Species*, vol. i, p. 84—243.

* Turnera guyanensis, mimosa pigra, m. *dormiens*.

† Cypura *graminea*, craniolaria annua (the *scorzonera* of the natives).

tribute this difference to the shelter afforded by the palm-trees, in preventing the solar rays from drying and burning up the soil. I have seen, it is true, trees of this family in the forests of the Oroonoko spreading a tufted foliage; but we cannot boast of the shade of the palm-tree of the Llanos, the *palma de cobija**, which has but a few folded and palmate leaves, like those of the chamærops, and of which the lowermost are constantly withered. We were surprised to see, that almost all these trunks of the corypha were nearly of the same size. They were from twenty to twenty-four feet high, and from eight to ten inches diameter at the foot. Nature has produced few species of palm-trees in such prodigious numbers. Amid thousands of trunks loaded with fruit of the shape of an olive, we found about one hundredth part without fruit. Are there some trees with flowers purely monœcious, mingled with others furnished with hermaphrodite flowers?

The *Llaneros*, or inhabitants of the plains, believe that all these trees, though so low, are many centuries old. Their growth is almost imperceptible, being scarcely to be noticed in the lapse of twenty or thirty years. The wood of the *palma de cobija* is excellent for building.

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* *Roofing* (or covering) *palm-tree: corypha tectorum.* See above, p. 186.

It is so hard, that it is difficult to drive a nail into it. The leaves folded like a fan are employed to cover the roofs of the huts scattered through the Llanos; and these roofs last more than twenty years. The leaves are fixed by bending the extremity of the footstalks, which have been beaten beforehand between two stones, so that they may bend without breaking.

Beside the solitary trunks of this palm-tree, we find dispersed here and there in the steppes a few clumps, real groves *(palmares)*, in which the corypha is intermingled with a tree of the proteaceous family, called *chaparro* by the natives, which is a new species of rhopala[*], with hard and resonant leaves. The little groves of rhopala are called *chaparrales*; and it may be supposed, that, in a vast plain, where only two or three species of trees are to be found, the *chaparro*, which affords shade, is considered as a highly valuable plant. The corypha spreads through the Llanos of Caraccas from Mesa de Peja as far as Guayaval; farther North and North-West, near Guanare and San Carlos, it's place is taken by another species of the same genus, with leaves alike palmate but larger. It is called the *palma real de los Llanos* *. Other palm-trees rise to the South of Guayaval, especially the piritu with pinnate † leaves, and the *murichi (moriche)*, celebrated by father Gumilla under the name of *arbol de la vida* ‡. It is the sago-tree of America, furnishing "*victum et amictum* §," flour, wire, and thread to weave hammocks, baskets, nets, and clothing. It's fruit, of the form of the cones of the pine, and covered with scales, perfectly resembles those of the calamus rotang. It has somewhat the taste of the apple. When arrived at it's maturity, it is yellow within and red without. The araguato monkeys eat it with avidity; and the nation of Guaraounoes, whose whole existence, it may be said, is closely linked with that of the *murichi* palm-tree, draw from it a fermented liquor, slightly acid, and extremely refreshing. This palm-tree, with large shining leaves, folded like a fan, preserves a beautiful verdure at the period of the greatest drought. It's sight alone produces an agreeable sensation of coolness, and the *murichi*, loaded with scaly fruit, contrasts singularly with the mournful aspect of the *palma de cobija*, the foliage of which is always gray, and covered with dust. The Llaneros believe, that the former attracts the vapours in the air*; and that for this reason, water is constantly found at it's foot, when dug for to a certain depth. The effect is confounded with the cause. The *murichi* grows best in moist places; and it may rather be said, that the water attracts the tree. The natives of the Oroonoko, by analogous reasoning, admit, that the great serpents contribute to preserve humidity in a canton. "You would look in vain for water-serpents," said an old Indian of Javita to us gravely, "where there are no marshes; because the water collects no more, when you imprudently kill the serpents that attract it."

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[*] Near the embothrium, of which we found no species in the New Continent. The embothriums are represented in American vegetation by the genera lomatia and oreocallis. See our *Nov. Genera et Species*, vol. ii, p. 154.

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* This palm-tree of the plains must not be confounded with the *palma real* of Caraccas and of Curiepe with pinnate leaves. *Nov. Gen.*, p. 305.

† Perhaps an aiphanes.

‡ Muriche, or quiteve, mauritia flexuosa. See above, chap. ix, vol. iii, p. 211. (*Gumilla Orinoco illustrado*, 1745, vol. i, p. 162—172. *Gili*, *Storia Amer.*, vol. i, p. 166.

§ Pliny, lib. xii, c. vii.

We suffered greatly from the heat in crossing the *Mesa* de Calabozo. The temperature of the air augmented sensibly every time that the wind began to blow. The air was loaded with dust; and during these gusts the thermometer rose to 40° or 41°. We went slowly forward, for it would have been dangerous to leave the mules that carried our instruments. Our guides advised us to fill our hats with the leaves of the rhopala, to diminish the action of the solar rays on the hair and the crown of the head. We found relief from this expedient, which seemed to us particularly excellent, when we could procure the leaves of the pothos or some other aroidea.

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* If the head of the murichi were better furnished with leaves than it generally is, we might perhaps admit, that the soil round the tree preserves it's humidity from the influence of it's shade.

It is impossible to cross these burning plains, without inquiring whether they have always been in the same state; or whether they have been stripped of their vegetation by some revolution of nature. The stratum of mould now found on them is in fact very thin. The natives believe, that the *palmares* and the *chaparales* (the little groves of palm-trees and rhopala) were more frequent and more extensive before the arrival of the Spaniards. Since the Llanos have been inhabited and peopled with cattle become wild, the savannah is often set on fire, in order to meliorate the pasturage. Groups of scattered trees are accidentally destroyed with the gramina. The plains were no doubt less bare in the fifteenth century, than they now are; yet the first *Conquistadores*, who came from Coro, described them then as savannahs, where nothing could be perceived but the sky and the turf, which were generally destitute of trees, and difficult to traverse on account of the reverberation from the soil. Why does not the great forest of the Oroonoko extend to the North, on the left bank of that river? Why does it not fill that vast space, that reaches as far as the Cordillera of the coast, and which is fertilized by numerous rivers? This question is connected with all that relates to the history of our planet. If, indulging in geological reveries, we suppose, that the steppes of America, and the desert of Sahara, have been stripped of their vegetation by an irruption of the ocean; or that they formed originally the bottom of an inland lake; we may conceive, that thousands of years have not sufficed for the trees and shrubs to advance from the borders of the forests, from the skirts of the plains either naked or covered with turf, toward the centre, and darken so vast a space with their shade. It is more difficult to explain the origin of bare savannahs, enchased in forests, than to recognize the causes that maintain forests and savannahs within their ancient limits, like continents and seas.

We found the most cordial hospitality at Calabozo, in the house of the administrator of the *Real Hacienda*, Don Miguel Cousin. The town, situate between the banks of the Guarico and the Urituco, had at this period only five thousand inhabitants; but every thing denoted increasing prosperity. The wealth of most of the inhabitants consists in herds, under the management of farmers, who are called *hateros*, from the word *hato*, which signifies in Spanish a house or farm placed in the midst of pastures. The scattered population of the Llanos being accumulated on certain points, principally around towns, Calabozo reckons already five villages or missions in it's environs. It is computed, that 98,000 head of cattle wander in the pastures nearest to the town. It is very difficult to form an exact idea of the herds contained in the Llanos of Caraccas, Barcelona, Cumana, and the Spanish Guyana. Mr. Depons, who inhabited the town of Caraccas longer than I, and whose statistical statements are generally accurate, reckons in those vast plains, from the mouths of the Oroonoko to the lake of Maracaybo, 1,200,000 oxen, 180,000 horses, and 90,000 mules. He estimates the produce of these herds at 5,000,000 franks; adding to the value of the exportation the price of the hides consumed in the country *. There exist, it is believed, in the Pampas de Buenos Ayres, 12,000,000 cows, and 3,000,000 horses, without comprising in this enumeration the cattle that have no acknowledged proprietor †.

I shall not hazard any of these general estimations, from their nature too uncertain; but shall only observe, that, in the Llanos of Caraccas, the proprietors of the great *hatos* are entirely ignorant of the number of the cattle they possess. They only know that of the young cattle, which are branded every year with a letter or mark peculiar to each herd. The richest proprietors mark as many as 14,000 head every year; and sell to the number of five or six thousand. According to official documents *, the exportation of hides from the whole *Capitania General* amounted annually for the West India islands alone, to 174,000 skins of oxen, and 11,500 of goats. When we reflect, that these documents are taken from the books of the customhouses, where no mention is made of the fraudulent dealings in hides, we are tempted to believe, that the estimation of 1,200,000 oxen wandering in the Llanos, from the Rio Carony and the Guarapiche to the lake of Maracaybo, is much underrated. The port of Guayra alone exported annually from 1789 to 1792, 70,000 or 80,000 hides, entered in the customhouse books, scarcely one fifth of which was for Spain. The exportation from Buenos Ayres, at the end of the eighteenth century, was, according to Don Felix d'Azzara, 800,000 skins. The hides of Caraccas are preferred in the peninsula to those of Buenos Ayres; because the latter, on account of a longer passage, undergo a loss of twelve per cent in the tanning. The southern part of the savannahs, vulgarly called *Llanos de arriba*, is very productive in mules and oxen; but the pasturage being in general less good, these animals are obliged to be sent to other plains to be fattened before they are sold. The *Llano de Monai*, and all the *Llanos de abaxo*, abound less in herds, but the pastures are so fertile, that they furnish meat of an excellent quality for provisioning the coast. The mules, which are not fit for labour before the fifth year, and then bear the name of *mulas de saca*, are purchased on the spot at the price of fourteen or eighteen piastres. The horses of the Llanos, descending from the fine Spanish breed, are not very large; they are generally of a uniform color, brown-bay, like most of the wild animals. Suffering alternately from drought and floods, tormented by the stings of insects and the bite of the large bats, they lead a hard and uneasy life. After having enjoyed for some months the care of man, their good qualities are developed, and become sensible. A wild horse, in the Pampas of Buenos Ayres, is worth from half to a whole piastre; and in the Llanos of Caraccas from two to three piastres; but the price of the horse augments, when he has been broken in, and is fit for agricultural labour. Here are no sheep; we saw flocks only on the table-land of Quito.

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* *Depons, Voyage à la Terre Ferme*, vol. i, p. 10.

† *Azzara, Voyage au Paraguay*, vol. i, p. 30.

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* *Informe del Conde de Casa-Valencia*, manuscript, which we have already quoted several times.

The *hatos* of oxen have suffered considerably of late from troops of vagabonds, who roam over the steppes killing the animals merely to take their hides. This robbery has increased since the trade of the Lower Oroonoko is become more flourishing. For half a century, the banks of that great river, from the mouth of the Apure as far as Angostura, were known only to the missionary monks. The exportation of cattle took place from the ports of the northern coast only, Cumana, Barcelona, Burburata, and Porto-Cabello. This dependence on the coast is now much diminished. The southern part of the plains has established an internal connexion with the Lower Oroonoko; and this trade is the more brisk, as those who devote themselves to it easily escape the trammels of the prohibitory laws.

The greatest herds of cattle that exist in the Llanos of Caraccas are those of the *hatos* of Merecure, la Cruz, Belen, Alta Gracia, and Pavon. The Spanish cattle came from Coro and Tocuyo into the plains. History has preserved the name of the colonist, who first conceived the happy idea of peopling these pasturages, in which deer only brouzed, and a large species of cavy, the thick-nosed tapir, or river cavy, *cavia capybara*, called *chiguire* in those countries. Christoval Rodriguez sent the first horned cattle into the *Llanos* *, about the year

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* *Fray Pedro Simon*, not. 5, cap. xiv, No. 2, p. 371.

1548. He was an inhabitant of the town of Tocuyo, and had long resided in New Grenada.

When we hear of the "innumerable quantity" of oxen, horses, and mules, that are spread over the plains of America, we seem generally to forget, that in civilized Europe, on lands of much less extent, there exist in agricultural countries quantities no less prodigious. France, according to Mr. Peuchet, feeds 6,000,000 of large horned cattle, of which there are 3,500,000 oxen employed in drawing the plough. In the Austrian monarchy the number of oxen, cows, and calves, is estimated by Mr. Lichtenstein at 13,400,000 head. Paris alone consumes annually 155,000 horned cattle *. Germany receives 150,000 oxen yearly from Hungary. Domestic animals, collected in small herds, are considered by agricultural nations as a secondary object in the riches of the state. Accordingly they strike the imagination much less than those wandering droves of oxen and horses, which fill alone the uncultivated tracts of the New World. Civilization and social order favour alike the progress of population, and the multiplication of animals useful to man.

We found at Calabozo, in the midst of the

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* 72,000 oxen, 9,000 cows, 74,000 calves, according to the official statement of 1817; the population of Paris being 713,765 individuals. Paris consumes besides 328,000 sheep, and 74,000 hogs; in all, 77,300,000 pounds of butcher's meat.

Llanos, an electrical machine with large plates, electrophori, batteries, and electrometers; an apparatus nearly as complete as our first scientific men in Europe possess. All these articles had not been purchased in the United States; they were the performance of a man, who had never seen any instrument, who had no person to consult, and who was acquainted with the phenomena of electricity only by reading the treatise of Sigaud de la Fond, and Franklin's Memoirs. Mr. Carlos del Pozo, the name of this worthy and ingenious man, had begun to make cylindrical electrical machines, by employing large glass jars, after having cut off the necks. It was only within a few years he had been able to procure, by way of Philadelphia, two plates, to construct a plate machine, and to obtain more considerable effects. It is easy to judge what difficulties Mr. Pozo had to encounter, since the first works upon electricity had fallen into his hands; and that he had the courage to resolve to procure himself, by his own industry, all that he had seen described in the books. Till now he had enjoyed only the astonishment and admiration produced by his experiments on persons destitute of all information, and who had never quitted the solitude of the Llanos; our abode at Calabozo gave him a satisfaction altogether new. It may be supposed, that he set some value on the opinions of two travellers, who could compare his apparatus with those constructed in Europe. I had brought with me electrometers, with straws, with pith balls, and with gold leaves; and also a small Leyden vial, which could be charged by friction according to the method of Ingenhousz, and which served for my physiological experiments. Mr. Pozo could not contain his joy, on seeing for the first time instruments which he had not made, and which appeared to be copied from his own. We also showed him the effect of the contact of heterogeneous metals on the nerves of frogs. The names of Galvani and Volta had not yet resounded in those vast solitudes.

After this electrical apparatus, the work of the industrious sagacity of an inhabitant of the Llanos, nothing at Calabozo excited in us so great an interest as the gymnoti, which are animated electrical apparatuses. Occupied daily for a great number of years by the phenomena of galvanic electricity; given up to that enthusiasm, which excites us to research, but prevents us from seeing accurately what we have discovered; having constructed, unconsciously, real *piles*, by placing metallic disks one upon another, and making them alternate with pieces of muscular flesh, or with other humid substances *; I was impatient, from the time of my arrival at Cumana, to procure electrical eels. We had been promised them often, but our hopes had always been disappointed. Money loses it's value as you withdraw from the coast; and how is the imperturbable phlegm of the vulgar to be vanquished, when they are not excited by the desire of gain?

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* See my Experiments on the irritable Fibre, vol. i, p. 74, pl. iii, iv, v, of the German edition.

The Spaniards confound all electrical fishes under the name of *tembladores (producers of trembling*, literally *tremblers)*. There are some in the Caribbean sea, on the coast of Cumana. The Guayqueria Indians, who are the most skilful and industrious fishermen in those parts, brought us a fish, which, they said, had benumbed their hands. This fish ascends the little river Manzanares. It is a new species of the ray, the lateral spots of which are scarcely visible, and which much resembles the torpedo of Galvani. The torpedoes, furnished with an electric organ that is externally visible, on account of the transparency of the skin, form a genus or subgenus, different from the rays properly so called *. The torpedo of Cumana was very lively, very energetic in it's muscular movements, and yet the electrical shocks it gave us were extremely feeble. They became stronger on *galvanizing* the animal by the contact of zinc and gold. Other *tembladores*, real gymnoti or electrical eels, inhabit the Rio Colorado, the Guarapiche, and several little streams, that cross the missions of the Chayma Indians. They abound also in the large rivers of America, the Oroonoko, the Amazon, and the Meta; but the strength of the current, and the depth of the water, prevent their being caught by the Indians. They see these fish less frequently than they feel electrical shocks from them when swimming or bathing in the river. In the *Llanos*, particularly in the environs of Calabozo, between the farms of Morichal and the missions *de arriba* and *de abaxo*, the basins of stagnant water, and the confluents of the Oroonoko, (the Rio Guarico and the *Canos* of Rastro, Berito, and Paloma) are filled with electrical eels. We at first wished to make our experiments in the house we inhabited at Calabozo; but the dread of the electrical shocks of the gymnoti is so great, and so exaggerated among the vulgar, that during three days we could not obtain one, though they are easily caught, and we had promised the Indians two piastres for every strong and vigorous fish. This fear of the Indians is the more extraordinary, as they do not attempt to employ means in which they profess to have great confidence. When interrogated on the effect of the *tembladores,* they never fail to tell the Whites, that they may be touched with impunity, while you are chewing tobacco. This fable of the influence of tobacco on animal electricity is as general on the continent of South America, as the belief among mariners of the effect of garlick and tallow on the magnetic needle.

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* *Cuvier, Regne Animal*, vol. ii, p. 136. The Mediterranean contains, according to Mr. Risso, four species of electrical torpedoes, all formerly confounded under the name of raia torpedo; these are torpedo narke, t. unimaculata, t. galvanii, and t. marmorata. The torpedo of the Cape of Good Hope, the subject of the recent experiments of Mr. Todd, is no doubt a nondescript species.

Impatient of waiting, and having obtained very uncertain results from an electrical eel that had been brought to us alive, but much enfeebled, we repaired to the Cano de Bera, to make our experiments in the open air, on the borders of the water itself. We set off on the 19th of March, at a very early hour, for the village of *Rastro de abaxo;* thence we were conducted by the Indians to a stream, which, in the time of drought, forms a basin of muddy water, surrounded by fine trees[*], the clusia, the amyris, and the mimosa with fragrant flowers. To catch the gymnoti with nets is very difficult, on account of the extreme agility of the fish, which bury themselves in the mud like serpents. We would not employ the *barbasco,* that is to say, the roots of the piscidea erithryna, jacquinia armillaris, and some species of phyllanthus, which, thrown

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[†] Amyris *lateriflora,* a. *coriacea,* laurus *pichurim,* myroxylon *secundum,* malpighia *reticulata.*

into the pool, intoxicate or benumb these animals. These means would have enfeebled the gymnoti; the Indians therefore told us, that they would "fish with horses," *embarbascar con cavallos* *. We found it difficult to form an idea of this extraordinary manner of fishing; but we soon saw our guides return from the savannah, which they had been scouring for wild horses and mules. They brought about thirty with them, which they forced to enter the pool.

The extraordinary noise caused by the horses' hoofs makes the fish issue from the mud, and excites them to combat. These yellowish and livid eels, resembling large aquatic serpents, swim on the surface of the water, and crowd under the bellies of the horses and mules. A contest between animals of so different an organization furnishes a very striking spectacle. The Indians, provided with harpoons and long slender reeds, surround the pool closely; and some climb upon the trees, the branches of which extend horizontally over the surface of the water. By their wild cries, and the length of their reeds, they prevent the horses from running away, and reaching the bank of the pool. The eels, stunned by the noise, defend themselves by the repeated discharge of their electric batteries. During a long time they seem to prove victorious. Several horses sink beneath the violence of the invisible strokes, which they receive from all sides in organs the most essential to life; and stunned by the force and frequency of the shocks, disappear under the water. Others, panting, with mane erect, and haggard eyes, expressing anguish, raise themselves, and endeavour to flee from the storm by which they are overtaken. They are driven back by the Indians into the middle of the water; but a small number succeed in eluding the active vigilance of the fishermen. These regain the shore, stumbling at every step, and stretch themselves on the sand, exhausted with fatigue, and their limbs benumbed by the electric shocks of the gymnoti.

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* Properly *to set to sleep*, or *intoxicate* the fish by means of horses.

In less than five minutes two horses were drowned. The eel, being five feet long, and pressing itself against the belly of the horses, makes a discharge along the whole extent of it's electric organ. It attacks at once the heart, the intestines, and the *plexus cœliacus* of the abdominal nerves. It is natural, that the effect felt by the horses should be more powerful, than that produced upon man by the touch of the same fish at only one of his extremities. The horses are probably not killed, but only stunned. They are drowned from the impossibility of rising amid the prolonged struggle between the other horses and the eels.

We had little doubt, that the fishing would terminate by killing successively all the animals engaged; but by degrees the impetuosity of this unequal combat diminished, and the wearied gymnoti dispersed. They require a long rest*, and abundant nourishment, to repair what they have lost of galvanic force. The mules and horses appear less frightened; their manes are no longer bristled, and their eyes express less dread. The gymnoti approach timidly the edge of the marsh, where they are taken by means of small harpoons fastened to long cords. When the cords are very dry, the Indians feel no shock in raising the fish into the air. In a few minutes we had five large eels, the greater part of which were but slightly wounded. Some were taken by the same means toward the evening.

The temperature of the waters, in which the gymnoti habitually live, is from 26° to 27°.

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* The Indians assured us, that when the horses are made to run two days successively into the same pool, none are killed the second day. See, on the fishing for gymnoti, and for the particulars of the experiments made at Calabozo, a memoir published in my *Observations de Zoologie*, vol. i, p. 59—92.; and my *Tableaux de la Nature*, vol. i, p. 53—57. I have been enabled to add here some new considerations, founded on a more intimate knowledge of the action of electromotive apparatuses.

Their electric force diminishes, it is said, in colder waters; and it is remarkable, that in general, as a celebrated naturalist has already observed, animals endowed with electromotive organs, the effects of which are sensible to man, are not found in the air, but in a fluid that is a conductor of electricity. The gymnotus is the largest of electrical fishes. I measured some, that were from five feet to five feet three inches long; and the Indians assert, that they have seen still longer. We found, that a fish of three feet ten inches long weighed twelve pounds. The transverse diameter of the body, without reckoning the anal fin, which is elongated in the form of a keel, was three inches five lines. The gymnoti of *Cano de Bera* are of a fine olive-green. The under part of the head is yellow mingled with red. Two rows of small yellow spots are placed symmetrically along the back, from the head to the end of the tail. Every spot contains an excretory aperture. In consequence, the skin of the animal is constantly covered with a mucous matter, which, as Volta has proved, conducts electricity twenty or thirty times better than pure water. It is in general somewhat remarkable, that no electrical fish, yet discovered* in the different parts of the world, is covered with scales.

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* We yet know with certainty only seven electrical fishes:

The gymnoti, like our eels, are fond of swallowing and breathing air on the surface of the water; but we must not thence conclude with Mr. Bajon, that the fish would perish, if it could not come up to breathe the air. Our eels wander a part of the night upon the grass, while I have seen a very vigorous gymnotus, that had sprung out of the tub, die on the ground. Mr. Provençal and myself have proved, by our researches on the respiration of fishes, that their humid bronchiæ can execute the double function of decomposing the atmospheric air, and of appropriating the oxygen dissolved in water. They do not suspend their respiration

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torpedo narke Risso, t. unimaculata, t. marmorata, t. galvanii, silurus electricus, tetraodon electricus, gymnotus electricus. It appears uncertain, whether the trichiurus indicus have electrical properties or not (*Cuv. Règne animal*, vol. ii, p. 247). But the genus torpedo, very different from that of the rays properly so called, has numerous species in the equatorial seas; and it is probable, that there exist several gymnoti specifically different. The Indians mentioned to us a very black and very powerful species, inhabiting the marshes of the Apure, which never attains a length of more than two feet, but which we were not able to procure. The *raton* of the Rio de la Magdalena, which I have described under the name of gymnotus æquilabiatus (*Observ. de Zoologie*, vol. i, pl. x, fig. 1), forms a particular subgenus. This is a carapa, not scaly, and without an electrical organ. This organ is also entirely wanting in the Brazilian carapo, and in all the rays, which Mr. Cuvier has had the goodness to examine again at my request.

in the air; but they absorb the gazeous oxygen, like a reptile furnished with lungs. It is known, that carp may be fattened by being fed out of the water, and wetting their gills from time to time with humid moss, to prevent their drying. Fish separate their gill-covers wider in oxygen gas, than in water. Their temperature, however, does not rise; and they live the same length of time in pure vital air, and in a mixture of ninety parts azot and ten oxygen. We found, that tench (cyprinus tinca), placed under inverted jars filled with air, absorb half a cubic centimetre of oxygen in an hour. This action takes place in the gills only; for fishes, on which a collar of cork has been fastened, and leaving their head out of the jar filled with air, do not act upon the oxygen * by the rest of their body.

The swimming-bladder of the gymnotus, the existence of which Mr. Bloch has denied, is two feet five inches long in a fish of three feet ten inches †. It is separated by a mass of fat from

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* *Mém. de la Société d'Arcueil*, vol. ii, p. 398. Is the respiration in the air effected through the intermedium of a plate of water, infinitely thin, which moistens the gills?

† Mr. Cuvier has shown me, since my return to Europe, that in the gymnotus electricus there exists, besides the large swimming bladder, another bladder, situate before it, and much smaller. It looks like the bifurcated swimming bladder in the gymnotus æquilabiatus, of which I made a drawing.

the external skin; and rests upon the electric organs, which fill more than two thirds of the animal. The same vessels, which penetrate between the plates or leaves of these organs, and which cover them with blood when they are cut transversely, send out also numerous branches to the exterior surface of the air-bladder. I found in a hundred parts of the air of the swimming-bladder four of oxygen and ninety-six of azot. The medullary substance of the brain displays but a feeble analogy with the albuminous and gelatinous matter of the electric organs. But these two substances have in common the great quantity of arterial blood which they receive, and which is disoxidated in them. We shall again remark on this occasion, that an extreme activity in the functions of the brain causes the blood to flow more abundantly toward the head; as the energy of the movement of the muscles accelerates the disoxidation of the arterial blood. What a contrast between the multitude and the diameter of the blood-vessels of the gymnotus, and the small space occupied by it's muscular system! This contrast reminds the observer, that three functions of animal life, which appear in other respects sufficiently distinct, the functions of the brain, those of the electrical organ, and those of the muscles, all require the afflux and concourse of arterial or oxygenated blood.

It would be temerity to expose ourselves to the first shocks of a very large and strongly irritated gymnotus. If by chance you receive a stroke before the fish is wounded, or wearied by a long pursuit, the pain and numbness are so violent, that it is impossible to describe the nature of the feeling they excite. I do not remember having ever received from the discharge of a large Leyden jar, a more dreadful shock, than that which I experienced by imprudently placing both my feet on a gymnotus just taken out of the water. I was affected the rest of the day with a violent pain in the knees, and in almost every joint. To be aware of the difference, which is sufficiently striking, that exists between the sensation produced by the pile of Volta and an electrical fish, the latter should be touched when they are in a state of extreme weakness. The gymnoti and the torpedoes then cause a twitching *, which is propagated from the part that rests on the electric organs as far as the elbow. We seem to feel at every stroke an internal vibration, that lasts two or three seconds, and is followed by a painful numbness. Accordingly the Tamanack Indians call the *temblador*, in their expressive language, *arimna*, which means *something that deprives of motion*.

The sensation caused by the feeble shocks of an electrical eel appeared to me analogous to that painful twitching, with which I have been seized at each contact of two heterogeneous metals applied to wounds, which I had made on my back by means of cantharides *. This difference of sensation between the effects of electrical fishes and those of the pile or a Leyden vial weakly charged has struck every observer; there is however nothing in this contrary to the supposition of the identity of electricity and the galvanic action of fishes. The electricity may be the same; but it's effects will be variously modified by the disposition of the electrical apparatus, by the intensity of the fluid, by the rapidity of the current, and by a particular mode of action.

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* *Subsultus tendinum.*

In Dutch Guyana, at Demerary for instance, electrical eels were formerly employed to cure the paralytic. At a time when the physicians of Europe had great confidence in the effects of electricity, a surgeon of Essequibo, Mr. Van der Lott, published in Holland a treatise on the medical properties of the gymnoti. These *electrical cures* are found among the savages of America, as well as among the Greeks. We are told by Scribonius Largus, Galen, and Dioscorides, that torpedoes cure the headach and the gout. I did not hear of this species of remedy in the Spanish colonies which I visited; but I can assert, that, after having made experiments during four hours successively with gymnoti, Mr. Bonpland and myself felt till the next day a debility in the muscles, a pain in the joints, and a general uneasiness, which was the effect of a strong irritation of the nervous system.

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* *Versuche ueber die gereizte Muskelfaser*, vol. i, p. 323—329.

Gymnoti are neither charged conductors, nor batteries, nor electromotive apparatuses, the shock of which is received every time they are touched with one hand, or when both hands are applied to form a conducting circle between two heterogeneous poles. The electric action of the fish depends entirely on it's will; whether because it do not keep it's electric organs always charged; or by the secretion of some fluid, or by any other means alike mysterious to us, it be capable of directing the action of it's organs to an external object. We often tried, both insulated and uninsulated, to touch the fish, without feeling the least shock. When Mr. Bonpland held it by the head, or by the middle of the body, while I held it by the tail, and, standing on the moist ground, did not take each other's hand, one of us received shocks, which the other did not feel. It depends upon the gymnotus to act toward the point, where it finds itself the most strongly irritated. The discharge is then made at one point only, and not at the neighbouring points. If two persons touch the belly of the fish with their fingers, at an inch distance, and press it simultaneously, sometimes one, sometimes the other will receive the shock. In the same manner, when one insulated person holds the tail of a vigorous gymnotus, and another pinches the gills, or pectoral fin, it is often the first only by whom the shock is received. It did not appear to us, that these differences could be attributed to the dryness or dampness of our hands, or to their unequal conducting power. The gymnotus seemed to direct it's strokes sometimes from the whole surface of it's body, sometimes from one point only. This effect indicates less a partial discharge of the organ composed of an innumerable quantity of leaves; than the faculty which the animal possesses, perhaps by the instantaneous secretion of a fluid spread through the cellular membrane, of establishing the communication between it's organs and the skin only, in a very limited space.

Nothing proves more strongly the faculty, which the gymnotus possesses, of darting and directing it's stroke according to it's will, than the observations made at Philadelphia, and recently at Stockholm *, on gymnoti rendered

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* By Messrs. Williamson and Fahlberg. The following account is given by the latter gentleman in an interesting note, published in the *Vetensk. Acad. nya Handl.*, quart. 2,

extremely tame. When they had been made to fast a long time, they killed from afar small fishes put into the tub. They acted at a distance; that is to say, their electrical stroke passed through a very thick stratum of water. We need not be surprised, that what was observed in Sweden, on a single gymnotus only, we could not see on a great number of individuals in their native country. The electric action of animals being *a vital action*, and subject to their will, it does not depend solely on their state of health

(1801), p. 122—156. "The gymnotus sent from Surinam to Mr. Norderling at Stockholm, lived more than four months in a state of perfect health. It was twenty-seven inches long; and the shocks it gave were so violent, especially in the air, that I found scarcely any means of protecting myself from it by nonconductors, in transporting the fish from one place to another. It's stomach being very small, it ate only a little at a time, but often. It approached living fish, sending them *(from afar)* a shock, the energy of which was proportionate to the size of the prey. The gymnotus was seldom mistaken *in it's judgment*; one single stroke was almost always sufficient to overcome the resistance (the obstacles, which the strata of water, more or less thick according to the distances, opposed to the electrical current). When very much pressed by hunger, it directed the shocks sometimes also against the person, who daily brought it's food of boiled meat not seasoned. Persons afflicted with rheumatism came to touch it in hopes of being cured. They took it at once by the neck and tail: the shocks were in this case stronger, than when touched with one hand only. It lost almost entirely it's electrical power a short time before it's death."

and vigour. A gymnotus, that has made the voyage from Surinam to Philadelphia and Stockholm, accustoms itself to the imprisonment, to which it is reduced; it resumes by degrees the same habits in the tub, which it had in the rivers and pools. An electrical eel was brought to me at Calabozo, taken in a net, and consequently having no wound. It ate meat, and terribly frightened the little tortoises and frogs, which, not knowing the danger, placed themselves with confidence on it's back. The frogs did not receive the stroke till the moment when they touched the body of the gymnotus. When they recovered, they leaped out of the tub; and when replaced near the fish, they were frightened at it's sight only. We then observed nothing, that indicated *an action at a distance;* but our gymnotus, recently taken, was not yet sufficiently tamed, to attack and devour frogs. On approaching the finger, or metallic points, within the distance of half a line from the electric organs, no shock was felt. Perhaps the animal did not perceive the neighbourhood of this foreign body; or, if it did, we must suppose, that the timidity it felt in the commencement of it's captivity prevented it from darting forth it's energetic strokes, except when strongly irritated by an immediate contact. The gymnotus being immersed in water, I approached my hand, both armed and unarmed with a metal, within the distance of a few lines from the electric organs; yet the strata of water transmitted no shock, while Mr. Bonpland irritated the animal strongly by an immediate contact, and received some very violent shocks. If I had plunged the most delicate electroscopes we know, prepared frogs, into contiguous strata of water, they would no doubt have felt contractions at the moment when the gymnotus seemed to direct it's stroke elsewhere. Prepared frogs, placed immediately on the body of a torpedo, experience, according to Galvani, a strong contraction at every discharge of the fish.

The electrical organ of the gymnoti acts only under the immediate influence of the brain and the heart. On cutting a very vigorous fish through the middle of the body, the fore part alone gave me shocks. The shocks are equally strong, in whatever part of the body the fish is touched; it is most disposed however, to dart them forth, when the pectoral fin, the electrical organ, the lips, the eyes, or the gills are pinched. Sometimes the animal struggles violently with a person holding it by the tail, without communicating the least shock. Nor did I feel any when I made a slight incision near the pectoral fin of the fish, and *galvanized* the wound by the simple contact of two pieces of zinc and silver. The gymnotus bent itself convulsively, and raised it's head out of the water, as if affrighted by a sensation altogether new; but I felt no vibration in the hands, which held the two metals. The most violent muscular movements are not always accompanied by electric discharges.

The action of the fish on the organs of man is transmitted and intercepted by the same bodies, that transmit and intercept the electrical current of a conductor charged by a Leyden vial, or Volta's pile. Some anomalies, which we thought we observed, are easily explained, when we recollect, that even metals (as is proved from their ignition when exposed to the action of the pile) present a slight obstacle to the passage of electricity; and that a bad conductor annihilates the effect of a feeble electricity on our organs, while it transmits to us the effect of a very strong electricity. The repulsive force, that zinc and silver exercise between each other, being far superior to that between gold and silver, I have found, that, when a frog, prepared and armed with silver, is *galvanized* under water, the conducting arc of zinc produces contractions, as soon as one of it's extremities approaches the muscles within three lines distance; while an arc of gold does not excite the organs, when the stratum of water between the gold and the muscles is more than half a line thick. In the same manner, by employing a conducting arc composed of two pieces of zinc and silver soldered together endwise; and resting, as before, one of the extremities of the metallic arc on the ischiatic nerve, it is necessary, in order to produce contractions, to bring the other extremity of the conducting arc nearer and nearer to the muscles, in proportion as the irritability of the organs diminishes. Toward the end of the experiment, the slightest stratum of water prevents the passage of the electrical current, and it is only by the immediate contact of the arc with the muscles, that the contractions take place. I dwell on these effects, dependant on three *variable* circumstances; the energy of the electromotive apparatus, the conductibility of the medium, and the irritability of the organs that receive the impressions; as it is because experiments have not been sufficiently multiplied with a view to these three variable elements, that, in the action of electrical eels and torpedoes, the accidental circumstances have been taken for absolute conditions, without which the electric shocks are not felt.

In wounded gymnoti, which give feeble but very equal shocks, these shocks appeared to us constantly stronger on touching the body of the fish with a hand armed with metal, than with the naked hand. They are stronger also, when, instead of touching the fish with one hand, naked, or armed with metal, we press it at once with both hands, either naked or armed. These differences, I repeat, become sensible only when you have gymnoti enough at your disposal, to be able to choose the weakest; and the extreme equality of the electric discharges admits of distinguishing between the sensations felt alternately by the hand naked or armed with a metal, by one or both hands naked, and by one or both hands armed with metal. It is also in the case only of small shocks, weak and uniform, that the shocks are more sensible on touching the gymnotus with one hand (without forming a chain) with zinc, than with copper or iron.

Resinous substances, glass, very dry wood, horn, and even bones, which are generally believed to be good conductors, prevent the action of the gymnoti from being transmitted to man. I was surprised at not feeling the least shock on pressing wet sticks of sealingwax against the organs of the fish; while the same animal gave me the most violent strokes, when excited by means of a metallic rod. Mr. Bonpland received shocks, when carrying a gymnotus on two cords of the fibres of the palm-tree, which appeared to us extremely dry. A strong discharge makes it's way through very imperfect conductors. Perhaps also the obstacle, which the conducting arc presents, renders the discharge more painful. I touched the gymnotus with a wet pot of brown clay, without effect; yet I received violent shocks, when I carried the gymnotus in the same pot, because the contact was greater.

When two persons, insulated or not insulated, hold each other's hands, and one of these persons only touches the fish with the hand, either naked or armed with metal, the shock is most commonly felt by both at once. It happens however also, that, in the most painful shocks, the person who comes into immediate contact with the fish alone feels the shock. When the gymnotus is exhausted, or in a very weak state of excitability, and will no longer emit strokes on being irritated with one hand; the shocks are felt, in a very vivid manner, on forming the chain, and employing both hands. Even then however, the electric shock takes place only at the will of the animal. Two persons, one of whom holds the tail, and the other the head, cannot, by joining hands and forming a chain, force the gymnotus to dart his stroke.

In employing very delicate electrometers in a thousand ways, insulating them on a plate of glass, and receiving very strong shocks which passed through the electrometer, I could never discover any phenomenon of attraction or repulsion. The same observation was made by Mr. Fahlberg at Stockholm. This philosopher however has seen an electric spark, as Walsh and Ingenhousz had done before him at London, by placing the gymnotus in the air, and interrupting the conducting chain by two gold leaves pasted upon glass, and a line distant from each other. No person, on the contrary, has ever perceived a spark issue from the body of the fish itself. We have irritated it for a long time during the night, at Calabozo, in perfect darkness, without observing any luminous appearance. Having placed four gymnoti of unequal strength in such a manner as to receive the shocks of the most vigorous fish by *communication*, that is to say, by touching only one of the other fishes, I did not observe, that these last were agitated at the moment when the current passed by their bodies. Perhaps the current established itself only on the humid surface of the skin. We will not however conclude from this, that the gymnoti are insensible to electricity; and that they cannot fight with each other at the bottom of the pools. Their nervous system must be subject to the same agents as the nerves of other animals. I have indeed seen, that, on baring their nerves, they undergo muscular contractions at the simple contact of two-heterogeneous metals; and Mr. Fahlberg, of Stockholm, found, that his gymnotus was convulsively agitated, when placed in a copper vessel, and feeble discharges from a Leyden vial passed through it's skin.

After the experiments I had made on gymnoti, it became highly interesting to me, at my return to Europe, to know with precision the various circumstances, in which another electrical fish, the torpedo of our seas, gives or does not give shocks. Though this fish had been examined by a great number of natural philosophers, I found all that had been published on it's electrical effects extremely vague. It has been very arbitrarily supposed, that this fish acts like a Leyden vial, which may be discharged at will, by touching it with both hands; and this supposition appears to have led observers into error, who have devoted themselves to researches of this kind. Mr. Gay-Lussac and myself, during our journey to Italy, made a great number of experiments on torpedoes taken in the Gulf of Naples. These experiments furnish many results somewhat different from those I collected on the gymnoti. It is probable, that the cause of these anomalies proceeds rather from the inequality of electric power in the two fishes, than the different disposition of their organs *.

Though the power of the torpedo cannot be compared with that of the gymnoti, it is sufficient to cause very painful sensations. A person accustomed to electric shocks can with difficulty hold in his hands a torpedo of twelve or fourteen inches, and in possession of all it's vigour. When the animal no longer gives any but very feeble strokes under water, the shocks become more sensible if it be raised above the surface. I have

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* Geoffroy de St. Hilaire, in the *Ann. du Muséum*, vol. i, p. 392—407.

often observed the same phenomenon in *galvanizing* frogs.

The torpedo moves the pectoral fins convulsively, every time it emits a stroke; and this stroke is more or less painful, according as the immediate contact takes place by a greater or less surface. We have above observed, that the gymnotus gives the strongest shocks without making any movement with the eyes, head, or fins*. Is this difference caused by the position of the electric organ, which is not double in the gymnoti? or, does the movement of the pectoral fins of the torpedo directly prove, that the fish restores the electrical equilibrium by it's own skin, discharges itself by it's own body, and that we generally feel only the effect of a lateral shock?

We cannot discharge at will either a torpedo or a gymnotus, as we discharge at will a Leyden vial or a Voltaic pile. A shock is not always felt, even in touching the electric fish with both hands. We must irritate it, to make it give the shock. This action in the torpedoes, as well as in the gymnoti, is a *vital action;* it depends on the will only of the animal, which perhaps does not always keep it's electrical organs charged, or does not always employ the action of it's nerves to establish the chain between the positive and negative poles. This is certain, that the torpedo gives a long series of shocks with astonishing celerity; whether it be, that the plates or laminæ of his organs are not wholly exhausted, or that the fish recharges them instantaneously.

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* The anal fin of the gymnoti only has a sensible motion, when these fishes are excited under the belly, where the electric organ is placed.

The electric stroke is felt, when the animal is disposed to give it, whether we touch with a single finger only one of the surfaces of the organs, or apply both hands to the two surfaces, the superior and inferior, at once. In either case it is altogether indifferent, whether the person, who touches the fish with one finger or both hands, be insulated or not. All that has been said on the necessity of a communication with the damp ground, to establish a circuit, is founded on inaccurate observations.

Mr. Gay-Lussac made the important observation, that, when an insulated person touches the torpedo with one finger, it is indispensable, that the contact be immediate. The fish may with impunity be touched with a key, or any other metallic instrument; no shock is felt, when a conducting or nonconducting body is interposed between the finger and the electrical organ of the torpedo. This circumstance furnishes a great difference between the torpedo and the gymnotus, the latter giving his strokes through an iron rod several feet long.

When the torpedo is placed on a metallic plate of very little thickness, so that the plate touches the inferior surface of the organs, the hand that supports the plate never feels any shock, though another insulated person excites the animal, and the convulsive movement of the pectoral fins denotes the strongest and most reiterated discharges.

If, on the contrary, a person support the torpedo, placed upon a metallic plate, with the left hand, as in the foregoing experiment; and the same person touch the superior surface of the electrical organ with the right hand; a strong shock is then felt in both arms. The sensation is the same, when the fish is placed between two metallic plates, the edges of which do not touch, and the person applies both hands at once to these plates. The interposition of one metallic plate prevents the communication, if that plate be touched with one hand only, while the interposition of two metallic plates does not prevent the shock, when both hands are applied. In the latter case, it cannot be doubted, that the circulation of the fluid is established by the two arms.

If, in this situation of the fish between two plates, there exist any immediate communication between the edges of these two plates, no shock takes place. The chain between the two surfaces of the electric organ is then formed by the plates; and the new communication, established by the contact of the two hands with the two plates, remains without effect. We carried the torpedo with impunity between two dishes of metal, and felt the strokes it gave only at the instant when the dishes no longer touched each other at the edges.

Nothing in the torpedo, or in the gymnotus, indicates, that the animal modifies the electrical state of the bodies by which it is surrounded. The most delicate electrometer is no way affected, in whatever manner it is employed, whether bringing it near the organs, or insulating the fish, covering it with a metallic plate, and causing the plate to communicate by a conducting wire with the condenser of Volta. We were at great pains to vary the experiments, by which we sought to render the electrical tension in the organs of the torpedo sensible; but they were constantly without effect, and perfectly confirmed what Mr. Bonpland and myself had observed respecting the gymnoti during our abode in South America.

Electrical fishes, when very vigorous, act with the same energy under water and in the air. This observation led us to examine the conducting property of water; and we found, that, when several persons form the chain between the superior and inferior surface of the organs of the torpedo, the shock is felt only when these persons have united their hands. The action is not intercepted, if two persons, who support the torpedo with their right hands, instead of taking one another by the left hand, plunge each a metallic point into a drop of water placed on an insulating substance. On substituting flame for the drop of water, the communication is interrupted, and is only reestablished, as in the gymnoti, when the two points immediately touch each other in the interior of the flame.

We are very far, unquestionably, from having revealed all the secrets of the electrical action of fishes, which is modified by the influence of the brain and the nerves; but the experiments, which we have just related, are sufficient to prove, that these fishes act by a *concealed* electricity, and by electromotive apparatuses of a peculiar construction, which are recharged with extreme rapidity. Mr. Volta admits, that the discharges of the contrary electricities in the torpedoes and the gymnoti are made by their own skin; and that, when we touch them with one hand only, or by means of a metallic point, we feel the effect of a *lateral shock*, the electrical current not being directed solely the shortest way. When a Leyden vial is placed on a wet woollen cloth, which is a bad conductor, and the vial is discharged in such a manner, that the cloth makes part of the chain; prepared frogs, placed at different distances, indicate by their contractions, that the current spreads itself over the whole cloth in a thousand different ways. According to this analogy, the most violent shock given by the gymnotus at a distance would be but a feeble part of the stroke, that reestablishes the equilibrium in the interior of the fish *. As the gymnotus directs it's fluid where it pleases, it must also be admitted, that the discharge is not made by the whole skin at once; but that the animal, excited perhaps by means of the motion of a fluid poured into one part of the cellular membrane, establishes at will the communication between it's organs and

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* The heterogeneous poles of the double electrical organs must be found in *each* organ. Mr. Todd has recently proved, by experiments made on torpedoes of the Cape of Good Hope, that the animal continues to give violent shocks, when one of these organs is extirpated. On the contrary, all electrical action is stopped, and this point, already elucidated by Galvani, is of the greatest importance, if a great injury be done to the brain, or if the nerves, which supply the plates of the electrical organs, be divided. In the latter case, the nerves being cut, and the brain left untouched, the torpedo continues to live, and perform every muscular movement. A fish, exhausted by too numerous electrical discharges, suffered much more than another fish, deprived, by dividing the nerves, of any communication between the brain and the electromotive apparatus. *Phil. Trans.*, 1816, part I, p. 120.

such or such a part of the skin. It may be conceived, that a lateral stroke, out of the direct current, must become imperceptible under the two conditions of a very weak discharge, or a very great obstacle presented by the nature and length of the conductor. Notwithstanding these considerations, it appears to me very surprising, that shocks of the torpedo, very strong in appearance, are not propagated to the hand, when a very thin plate of metal is interposed between it and the fish.

Doctor Schilling had announced, that the gymnotus approached the loadstone involuntarily. We were astonished to find this idea adopted by Mr. Pozo. We tried in a thousand ways this pretended influence of the magnet on the electrical organs, without having ever observed any sensible effect. The fish no more approached the loadstone, than a bar of iron not magnetic. Iron filings thrown on it's back remained motionless.

The gymnoti, objects of predilection and of the most lively interest to the philosophers of Europe, are at once dreaded and detested by the natives. They furnish indeed, in their muscular flesh, a pretty good aliment; but the electric organ fills the greater part of their body, and this organ is slimy and disagreeable to the taste; and accordingly it is separated with care from the rest of the body. The presence of the gymnoti is also considered as the principal cause of the want of fish in the ponds and pools of the Llanos. The gymnoti kill many more than they devour: and the Indians told us, that when they take young alligators and gymnoti at the same time in very strong nets, the latter never display the slightest trace of a wound, because they disable the young alligators before they are attacked by them. All the inhabitants of the waters dread the society of the gymnoti. Lizards, tortoises, and frogs seek the pools, where they are secure from their action. It became necessary to change the direction of a road near Uritucu, because these electrical eels were so numerous in one river, that they every year killed a great number of mules of burden, as they forded the water.

Though in the present state of our knowledge we may flatter ourselves with having thrown some light on the extraordinary effects of electrical fishes, a great number of physical and physiological researches still remain to be made. The brilliant results, which chemistry has obtained by means of the pile, have occupied all observers, and turned attention for some time from the examinations of the phenomena of vitality. Let us hope, that these phenomena, the most awful and the most mysterious of all, will occupy in their turn the sagacity of natural philosophers. This hope will be easily realized, if they succeed in procuring anew living gymnoti in one of the great capitals of Europe. The discoveries that will be made on the electromotive apparatus of these fish, much more energetic, and more easy to preserve, than the torpedoes *, will extend to all the phenomena of muscular motion subject to the will. It will perhaps be found, that, in most animals, every contraction of the muscular fibre is preceded by a discharge from the nerve into the muscle; and that the simple contact of heterogeneous substances is a source of movement and of life

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* In order to investigate the phenomena of the living electromotive apparatus in their greatest simplicity; and not to mistake circumstances, which depend on the degree of energy of the electric organs, for general conditions; it is necessary, to perform the experiments on those electrical fishes that are most easily tamed. If the gymnoti were not known, we might suppose from the observations made on torpedoes, that fishes cannot give their shocks from a distance through very thick strata of water, or through a bar of iron, without forming a circuit. Mr. Williamson has felt strong shocks, when he held only one hand in the water, and this hand, without touching the gymnotus, was placed between it and the small fish, toward which the stroke was directed from twelve or fifteen inches distance. (Phil. Trans., vol. lxv, p. 99 and 108.) When the gymnotus was enfeebled (in a bad state of health), the *lateral shock* was imperceptible; and in order to feel the shock it was necessary, to form a chain, and touch the fish with both hands at once. Cavendish, in his ingenious experiments on an *artificial torpedo*, had well remarked these differences, depending on the greater or less energy of the charge. (Phil. Trans., 1776, p. 212.)

in all organized beings. Did an ingenious and lively people, the Arabians, guess from remote antiquity, that the same force, which inflames the vault of Heaven in storms, is the living and invisible weapon of inhabitants of the water? It is asserted, that the electrical fish of the Nile bears a name in Egypt, that signifies *thunder* *.

We left the town of Calabozo on the 24th of March, highly satisfied with our abode, and the experiments we had made on an object so worthy of the attention of physiologists. I had besides obtained some good observations of the stars; and discovered with surprise, that the errors of maps amounted here also to a quarter of a degree of latitude. No person had taken an observation before me on this spot; and geographers, magnifying as usual the distance from the coast to the islands, have carried back beyond measure all the points toward the South †.

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* *Annal. du Mus.*, vol. i, p. 398. It appears however, that a distinction is to be made between *rahd*, thunder, and *rahadd*, the electrical fish; and that this latter word means simply *what causes trembling*. Silv. de Sacy, in *Abd-Allatif*, p. 167.

† I found the latitude of Calabozo, which in the map of Arrowsmith is called Calabaco, according to meridian altitudes of Canopus, to be 8° 56′ 8″: and the longitude, by the timekeeper adjusted at Caraccas, 70° 10′ 40″, that is 0° 16′ 56″ East of Guacara. D'Anville places Calabozo in 8° 38′; La Cruz, in 8° 43′. See my *Recueil d' Obs. Astr.*,

As we advanced into the southern part of the Llanos, we found the ground more dusty, more destitute of herbage, and more cracked by the effect of long drought. The palm-trees disappeared by degrees. The thermometer kept, from eleven in the morning till sunset, at 34° or 35°. The more the air appeared calm at

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vol. i, p. 212—215. The magnetic dip at Calabozo was 38·7° cent. div. The needle oscillated two hundred and twenty-two times in ten minutes, or ten oscillations less than at Caraccas. I obtained for the magnetic variation on the 18th of March, 1800, 4° 54′ 10″ N. E. The elevation of Calabozo above the level of the sea is 53 toises. (The *Nivellement Barométrique* indicates by mistake 94 toises. In the Journal was entered " Bar. 333·7^l, but 40 feet above the Rio Guarico." The feet were taken for toises.) I give here the following observations, for the most part not yet published. At the Hacienda de Cura my barometer indicated at 5^h (therm. cent. 27·6°) 320·5^l: at Guacara, at 10^h (th. 25°) 321·5^l: at Nueva Valencia, at 14^h (th. 26·4°) 320·4^l: at Guigue, at 2^h (th. 30·3°) 321·2^l: at Villa de Cura, at 6^h (th. 26·3°) 317·6^l: at San Juan, at 1^h (th. 25·2°) 322·8^l: at Parapara, at 23^h (th. 27·2°) 331·5^l: at Cayman, in the Llano, at 14^h (th. 28·3°) 333·3^l: at Calabozo, five toises above the river Guarico, at 23^h (th. 31·2°) 333·7^l: at St. Geronimo del Guayaval, at 21^h (th. 32°) three toises above the Rio Guarico, 336·4^l: at San Fernando de Apure, five toises above the level of the waters of the Apure, at 23^h (th. 31·4°) 335·6^l. These numbers give *differences of relative height*. The correction of the basin of the barometer has not been made to reduce the barometer to the level of the sea, 337·8^l. For the *absolute heights* consult my *Obs. Ast.*, vol. i, p. 297 and 367.

eight or ten feet high, the more we were enveloped in those whirlwinds of dust, caused by the little currents of air that sweep the ground. About four o'clock in the afternoon we found a young Indian girl stretched upon the savannah. She was quite naked, lay upon her back, and appeared to be only twelve or thirteen years of age. Exhausted with fatigue and thirst, her eyes, nostrils, and mouth filled with dust, she breathed with a rattling in her throat, and was unable to answer our questions. A pitcher overturned, and half filled with sand, was lying at her side. Happily one of our mules was laden with water; and we roused the young girl from her lethargic state by washing her face, and forcing her to drink a few drops of wine. She was at first frightened at seeing herself surrounded by so many persons; but by degrees she took courage, and conversed with our guides. She judged from the position of the Sun, that she must have remained during several hours in that state of lethargy. We could not prevail on her to mount one of our beasts of burden. She would not return to Uritucu. She had been in service at a neighbouring farm; and her masters had discharged her, because at the end of a long sickness they found she was less able to work than before. Our menaces and our prayers were fruitless; insensible to suffering, like the rest of her race, she persisted in her resolution of going to one of the Indian *missions*, that surround the city of Calabozo. We took the sand out of her pitcher, and filled it with water. She resumed her way along the steppe, before we had remounted our horses, and was soon separated from us by a cloud of dust. During the night we forded the Rio Uritucu *, which is filled with a breed of crocodiles remarkable for their ferocity. We were advised, to prevent our dogs from going to drink in the rivers; for it often happens, that the crocodiles of Uritucu come out of the water, and pursue dogs upon the shore. This intrepidity is so much the more striking, as at eight leagues distance the crocodiles of the Rio Tisnao are timid enough, and little dangerous. The manners of animals vary in the same species according to local circumstances difficult to investigate. We were shown a hut, or rather a kind of shed, in which our host of Calabozo, Don Miguel Cousin, had witnessed a very extraordinary scene. Sleeping with one of his friends on a bench covered with leather, Don Miguel was awakened early in the morning by violent shakes, and a horrible noise. Clods of earth were thrown into the middle of the hut. Presently a young crocodile two or three feet long issued from under the bed, darted at a dog that lay on the threshold of the door, and, missing him in the impetuosity of his spring, ran toward the beach to attain the river. On examining the spot where the *barbacon*, or bedstead, was placed, the cause of this strange adventure was easily discovered. The ground was disturbed to a considerable depth. It was dried mud, that had covered the crocodile in that state of lethargy, or *summer sleep*, in which many of the species lie during the absence of the rains amid the Llanos. The noise of men and horses, perhaps the smell of the dog, had awakened the crocodile. The hut being placed at the edge of the pool, and inundated during part of the year, the crocodile had no doubt entered, at the time of the inundation of the savannahs, by the same opening by which Mr. Pozo saw it go out. The Indians often find enormous *boas*, which they call *Uji*, or *water-serpents* *, in the same lethargic state. To reanimate them, they must be irritated, or wetted with water. Boas are killed, and immersed in the streams, to obtain, by means of putrefaction, the tendinous parts of the dorsal muscles, of which excellent strings for the guitar are made at Calabozo, preferable to those furnished by the intestines of the alouate monkeys.

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* *Passo de Uritucu.*

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* *Culebras de agua, traga-venado,* " swallower of stags.", The word uji belongs to the Tamanack language.

We have just seen, that the drought and heat of the Llanos act like cold upon animals and plants. Beyond the tropics the trees lose their leaves in a very dry air. Reptiles, particularly crocodiles and boas, having very indolent habits, leave with difficulty the basins where they have found water at the period of great inundations. In proportion as the pools become dry, these animals penetrate into the mud, in search of the degree of humidity that gives flexibility to their skin and integuments. In this state of repose they are seized with stupefaction: but they preserve a communication perhaps with the external air; and, however little this communication is, it may suffice to keep up the respiration of an animal of the *saurien* family, provided with enormous pulmonary bags, exerting no muscular motion, and in which almost all the vital functions are suspended*. It is probable, that the mean temperature of the dried mud, exposed to the solar rays, is more than 40°. When the North of Egypt, where the coolest† month does not fall below 13·4°, still sustained crocodiles, they were often found torpid with cold. They were subject to a *winter sleep*, like our frogs, our salamanders, our sand-martins, and our marmosets. If the *hibernal lethargy* be observed at once in animals with cold and those with hot blood, we shall be less surprised to learn, that these two classes furnish alike examples of a *summer sleep*. In the same manner as the crocodiles of South America, the *tenrecs* *, or Madagascar hedge-hogs, in the midst of the torrid zone, pass three months of the year in lethargy.

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* See my experiments on the respiration of young crocodiles in the *Obs. de Zoologie*, vol. i, p. 258.

† This is the mean temperature of the month of February at Cairo, lat. 30° 2′: toward Thebes the diminution of the temperature is naturally less.

On the 25th of March we traversed the smoothest part of the steppes of Caraccas, the *Mesa de Pavones*. It is entirely destitute of the corypha and murichi palm-trees. As far as the eye can reach not a single object fifteen inches high can be discovered. The air was clear, and the sky of a very deep blue; but the horizon reflected a livid and yellowish light, caused no doubt by the quantity of sand suspended in the atmosphere. We met some large herds, and with them flocks of birds of a black colour, with an olive reflection. They are of the genus crotophaga †, and follow the cattle. We had often seen them perched on the backs of cows, seeking for gadflies and other insects. Like many birds of these desert places, they fear so little the approach of man, that children often take them with the hand. In the valleys of Aragua, where they are very common, we have seen them perch upon our hammocks, while we were reposing in them in open day.

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* Centenes, Illiger. (Erinaceus ecaudatus, Lin.)

† The Spanish colonists call the crotophaga ani, *zamurito*, (little carrion vulture, vultur aura minuta), or *garapatero*, "*eater of garapatas*," insects of the family of acarides.

We discover between Calabozo, Uritucu, and the *Mesa de Pavones*, wherever men have made excavations of some feet deep, the geological constitution of the Llanos. A formation of red sandstone[*] (or ancient conglomerate) covers an extent of several thousand square leagues. We shall find it again hereafter in the vast plains of the Amazon, on the eastern boundary of the province of Jaën de Bracamoros. This prodigious extension of red sandstone, in the low grounds that stretch along the East of the Andes, is one of the most striking phenomena, with which the study of rocks in the equinoctial regions furnished me.

The red sandstone of the Llanos of Caraccas lies in a *concave position*[†], between the primitive mountains of the shore and of Parime. On the North it is backed by the transition slates[‡], and on the South it rests immediately on the granites of the Oroonoko. We observed in it rounded fragments of quartz, *kieselschiefer*, and

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[*] *Rothes todtes liegende*, or *æltester flætzsandstein* of the school of Freyberg; *poudingue psammitique* of Messrs. Brongniart and Bonnard.

[†] *Muldenformige lagerung.*

[‡] At Malpasso and Piodras Azules. See above, p. 289.

Lydian stone, cemented by an olive brown ferruginous clay. It is altogether the same formation as the *todteliegende* of Thuringia. The cement is sometimes of so vivid a red, that the people of the country take it for cinnabar. We found a Capuchin monk at Calabozo, who in vain attempted to extract mercury from this red sandstone. In the Mesa de Paja this rock contains strata of another quartzose sandstone, very fine-grained; more to the South it contains masses of brown iron, and fragments of petrified wood, of the monocotyledonous family; but we did not see in it any shells. The red sandstone, called by the Llaneros, *piedra de arrecifes* *, is every where covered with a stratum of clay. This clay, dried and hardened in the Sun, splits into separate prismatic pieces with five or six sides. Does it belong to the trap formation of Parapara? It becomes thicker, and mixed with sand, as we approach the Rio Apure; for near Calabozo it is one toise thick, near the mission of Guayaval five toises; which may lead to the belief, that the strata of red sandstone dip toward the South. We gathered in the Mesa de Pavones little nodules of *azure iron ore* disseminated in the clay †.

A dense, whitish-gray *limestone*, with a smooth fracture, somewhat analogous to the *formation of Caripe* [*], and consequently to that of Jura, lies on the red sandstone between Tisnao and Calabozo: in several other places, for instance in the *Mesa de San Diego*, and between Ortiz and the *Mesa de Paja* [†], we find above the limestone lamellar gypsum alternating with strata of marl. Considerable quantities of this gypsum are sent to the city cf Caraccas [‡], situate amid primitive mountains.

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* *Stone of the reefs.*

† *Blaue Eisenerde*, blue phosphated iron.

This gypsum generally forms only small beds, and is mixed with a great deal of fibrous gypsum. Is it of the same formation as that of Guire, on the coast of Paria, which contains sulphur? or do the masses of this latter substance, found in the valley of Buen Pastor and on the banks of the Oroonoko, belong, with the argillaceous gypsum of the Llanos, to a secondary formation much more recent [§]?

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[*] See vol. iii, chap. vi, p. 107; chap. viii, p. 175; chap. xi, p. 365. Does this formation of secondary limestone of the Llanos contain galena? It has been found in strata of black marl, at Barbacoa, between Truxillo and Barquesimeto, North-West of the Llanos.

[†] Also near Cachipe and San Juacquim, in the Llanos of Barcelona.

[‡] This trade is carried on at Parapara. A load of eight arobas sells at Caraccas for twenty-four piastres.

[§] See above, ch. ii, vol. i, p. 257; chap. vi, vol. iii, p. 108; and chap. xiv in the present volume.

These questions are very interesting in the study of the *relative antiquity* of rocks, which is the principal basis of geognosy. I know not of any formations of muriat of soda in the Llanos. Horned cattle prosper here without those famous *bareros*, or muriatiferous lands, that abound in the Pampas of Buenos Ayres.

After having wandered a long time, and always without any traces of a road, in the desert savannahs of the *Mesa de Pavones*, we were agreeably surprised to find a solitary farm, the *Hato de Alta Gracia*, surrounded with gardens and basins of limpid water. Hedges of bead-trees encircled groups of *icacoes* loaded with fruit. Farther on, we passed the night near the small village of *San Geronymo del Guayaval*, founded by Capuchin missionaries. It is situate near the banks of the Rio Guarico, which falls into the Apure. I visited the ecclesiastic, who had no other habitation than his church, not having yet built a house. He was a young man, and received us in the most obliging manner, giving us all the information we desired. His village, or to use the word established among the monks, his *mission*, was not easy to govern. The founder, who had not hesitated to establish for his own profit a *pulperia*, in other words, to sell bananas and *guarapo* in the church itself, had shown himself as little delicate in the choice of the new colonists. Many vagabonds of the

Llanos had settled at Guayaval, because the inhabitants of a *mission* are exempt from the authority of the secular arm. Here, as in New Holland, it cannot be expected, that good colonists will be formed before the second or third generation.

We passed the Guarico, and encamped in the savannahs South of Guayaval. Enormous bats, no doubt of the tribe of phyllostomes, hovered as usual over our hammocks a great part of the night. It seems at every moment as if they were going to fasten on the face. Early in the morning we pursued our way over low grounds, often inundated. In the season of rains, a boat may be navigated, as on a lake, between the Guarico and the Apure. We were accompanied by a man, who had visited all the farms *(hatos)* of the *Llanos*, in order to buy horses. He had given two thousand two hundred piastres for a thousand horses. The price of course is lower in proportion as the purchase is more considerable *. We arrived on the 27th of March at the

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* In the Llanos of Calabozo and of Guayaval, a young bull, two or three years old, costs one piastre. If castrated (an operation rather dangerous in so hot a climate) from five to six piastres. An ox hide dried in the Sun is worth two rials of plate and a half (one peso = eight rials); a hen, two rials; a sheep, at Barquesimeto and Truxillo, for there are none to the East of these towns, three rials. As these prices will necessarily vary in proportion as the Spanish

Villa de San Fernando, the capital of the mission of the Capuchins in the province of Varinas. This was the termination of our journey over thef *Plains*; for we passed the three months o April, May, and June on the rivers.

colonies augment in population, it appeared to me interesting to note these statements, which may one day serve as a foundation for some researches in political economy.

CHAPTER XVIII.

San Fernando de Apure.—Intertwinings, and bifurcations of the rivers Apure and Arauca.—Navigation on the Rio Apure.

Till the second half of the eighteenth century the names of the great rivers Apure, Arauca, and Meta were scarcely known in Europe; even less than they had been in the two preceding ages, when the valiant Felipe de Urre, and the conquerors of Tocuyo, traversed the Llanos, to seek beyond the Apure the great city of Dorado, and the rich country of the Omeguas, the Tombuctoo of the New Continent.. Such daring expeditions could not be made without all the apparatus of war; and the weapons, that were meant for the defence of the new colonists, were employed without intermission against the unhappy natives. When more peaceful times succeeded to those of violence and public calamity, two powerful Indian tribes, the Cabres and the Caribbees of the Oroonoko, rendered themselves masters of the country, which the

Conquistadores had ceased to ravage. Poor monks only were then permitted to advance to the South of the Steppes. An unknown world commenced for the Spanish colonists beyond the Urituca; and the descendants of those intrepid warriors, who had pushed their conquests from Peru to the coasts of New Grenada and the mouth of the Amazon, were ignorant of the roads that lead from Coro to the Rio Meta. The shore of Venezuela remained a separate country; and the slow conquests of the Jesuit missionaries were successful only by skirting the banks of the Oroonoko. These fathers had already penetrated beyond the great cataracts of Atures and Maypures, when the Andalusian Capuchins had scarcely reached the plains of Calabozo, from the coast and the valleys of Aragua. It would be difficult to explain these contrasts by the system according to which the different monastic orders are governed; it is the aspect of the country, that contributes powerfully to the more or less rapid progress of the missions. They extend slowly into the interior of the land on mountains, or in steppes wherever they do not follow the course of a particular river. It will scarcely be believed, that the Villa de Fernando de Apure, only fifty leagues distant in a direct line from that part of the coast of Caraccas the longest inhabited, was founded only in 1789. We were shown a parchment, full of fine paintings, containing the privileges of this little town. The parchment arrived from Madrid, at the solicitation of the monks, when yet only a few huts of reeds were to be seen around a great cross raised in the centre of the hamlet. The missionaries and the secular governments being alike interested in exaggerating in Europe what they have done to augment the culture and population of the provinces beyond sea, it often happens, that names of towns and villages are placed on the list of new *conquests,* long before their foundation. We shall point out some on the banks of the Oroonoko and the Cassiquiare, which, long projected, have never had any other existence than in the maps of the missions engraved at Rome and Madrid.

The situation of San Fernando, on a large navigable river, near the mouth of another river, that traverses the whole province of Varinas, is extremely advantageous for trade. Every production of that province, hides, cacao, cotton, and the indigo of Mijagual which is of the first quality, passes through this town toward the mouths of the Oroonoko. During the season of rains large vessels go from Angostura up as far as San Fernando de Apure, and by the Rio Santo Domingo as far as Torunos, the port of the town of Varinas. At that period the inundations of the rivers, which form a labyrinth of branches between the Apure, the Arauca, the Capanaparo, and the Sinaruco, cover a country of nearly four hundred square leagues. At this point the Oroonoko, turned aside from it's course, not by neighbouring mountains, but by the rising of counterslopes, runs toward the East, instead of following it's ancient direction in the line of the meridian. Considering the surface of the globe as a polyedron, formed of planes variously inclined *, we may conceive by the mere inspection of the maps, that the intersection of these slopes, rising toward the North, the West, and the South †, between San Fernando de Apure, Caycara, and the mouth of the Meta, must cause a considerable depression. The savannahs in this basin are covered with twelve or fourteen feet of water; and present, at the period of rains, the aspect of a great lake. The farms and villages placed on a sort of shoals, scarcely rise two or three feet above the surface of the water. Every thing here recalls to mind the

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* See a paper on the art of constructing canals, by Messrs. Dupuis-Torcy and Brissot, in the *Journal de l'Ecole Polytechnique*, vol. vii, p. 265.

† The risings toward the North and the West are connected with two *lines of ridges*, the mountains of Villa de Cura and of Merida. The third slope, running from North to South, is that of the *land strait*, between the Andes and the chain of Parime. It determines the general inclination [illegible] the Oroonoko, from the mouth of the Guaviare to that of the Apure.

inundations of Lower Egypt, and the lake of Xarayes, heretofore so celebrated among geographers, though it exists only during some months of the year. The swellings of the rivers Apure, Meta, and Oroonoko, are also periodical. In the rainy season the horses, that wander in the savannah, and have not time to reach the rising grounds of the *Llanos*, perish by hundreds. The mares are seen, followed by their colts *, swimming during a part of the day to feed upon the grass, the tops of which alone wave above the waters. In this state they are pursued by the crocodiles, and it is by no means uncommon to find the prints of the teeth of these carnivorous reptiles on their thighs. The carcases of horses, mules, and cows, attract an innumerable quantity of vultures. The *zamuros* † are the ibises, or rather the *aquiline vultures*, of this country. They have the mien of *Pharaoh's chicken*, and render the same service to the inhabitants of the Llanos as the vultur percnopterus to the inhabitants of Egypt.

We cannot reflect on the effects of these inundations, without admiring the prodigious pliability of the organization of the animals, that man has subjected to his sway. In Greenland the dog eats the refuse of the fisheries; and; when fish are wanting, feeds on seaweed. The ass, and the horse, originally natives of the cold and barren plains of Upper-Asia, follow man to the New World, return to the savage state, and lead a restless and painful life in the burning climate of the tropics. Pressed alternately, by excess of drought and of humidity, they sometimes seek a pool in the midst of a bare and dusty soil, to quench their thirst; and at other times flee from water, and the overflowing rivers, as menaced by an enemy that threatens them on all sides. Harrassed during the day by gadflies, and moschettoes, the horses, mules, and cows find themselves attacked at night by enormous bats, that fasten on their backs, and cause wounds that become dangerous, because they are filled with acaridæ and other hurtful insects. In the time of great drought, the mules gnaw even the thorny melocactus *, melon thistle, in order to drink it's cooling juice, and draw it forth as from a vegetable fountain. During the great inundations these same animals lead an amphibious life, surrounded by crocodiles, water-serpents, and manatees. Yet, such are

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* The colts are drowned every where in large numbers, because they are sooner tired of swimming, and strive to follow the mares in places where these alone can touch the ground.

† Vultur aura, L.; carrion vulture.

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* The asses are particularly adroit in extracting the [illegible]isture contained in the cactus melocactus. They push [illegible]e the thorns with their hoofs; but some become lame in consequence of this operation.

the immutable laws of nature, their races are preserved in the struggle with the elements, and amid so many sufferings and dangers. When the waters retire, and the rivers return again into their beds, the savannah is spread over with a fine odoriferous grass; and the animals of old Europe and Upper-Asia seem to enjoy, as in their native climate, the renewed vegetation of spring.

During the time of great floods, the inhabitants of these countries, to avoid the force of the currents, and the danger arising from the trunks of trees, which these currents bring down, instead of ascending in their boats the beds of rivers, cross the savannahs. To go from San Fernando to the villages of San Juan de Payara, San Raphael de Atamaica, or San Francisco de Capanaparo, they direct their course due South, as if they were crossing a single river of twenty leagues broad. The junctions of the Guarico, the Apure, the Cabullare, and the Arauca with the Oroonoko, form, at a hundred and sixty leagues from the coast of Guyana, a kind of interior Delta, of which hydrography furnishes few examples in the Old World. According to the height of the mercury in the barometer, the waters of the Apure have only a fall of thirty-four toises from San Fernando to the sea. The fall from the mouths of the Os[illegible] and the Missoury to the bar of the Missisippi is not more considerable. The savannahs of Lower Louisiana every where remind us of the savannahs of the Lower Oroonoko.

We remained three days in the little town of San Fernando. We lodged with the Capuchin missionary, who lived much at his ease. We were recommended to him by the bishop of Caraccas, and he showed us the most obliging attentions. He consulted me on the works, that had been undertaken to prevent the flood from undermining the shore, on which the town was built. The flowing of the Portuguesa into the Apure gives the latter an impulse toward the South-West; and, instead of procuring a freer course for the river, attempts were made to confine it by dykes and piers. It was easy to predict, that these would be the more rapidly destroyed by the swell of the waters, as the shore had been weakened by taking away the earth behind the dyke, to be employed in these hydraulic constructions.

San Fernando is celebrated for the excessive heat, that prevails there the greater part of the year: and before I begin the recital of our long navigation on the rivers, I shall relate some facts, that are calculated to throw light on the meteorology of the tropics. We went provided with thermometers to the flat shores, that border [illegible]e river Apure, which is covered with white sand. At two in the afternoon I found the sand, wherever it was exposed to the Sun, at 52·5°*. The instrument, raised eighteen inches above the sand, marked 42·8°; and at six feet high, 38·7°. The temperature of the air under the shade of a ceiba, was 36·2°. These observations were made during a dead calm. As soon as the wind began to blow, the temperature of the air rose 3°; yet we were not enveloped by a *wind of sand:* but the strata of air had been in contact with a soil more strongly heated, or through which *whirlwinds of sand* had passed. This western part of the Llanos is the hottest, because it receives air that has already crossed the rest of the barren steppe. The same difference has been observed between the eastern and western parts of the deserts of Africa, where the tradewinds blow.

The heat augments sensibly in the Llanos during the time of rains, particularly in the month of July, when the sky is cloudy, and sends back the radiant heat toward the earth. During this season the breeze entirely ceases; and, according to good thermometrical observations made by Mr. Pozo, the thermometer rises in the shade to 39° and 39·5° †, though kept at the distance of more than fifteen feet from the ground. As we approached the banks of the Portuguesa, the Apure, and the Apurito, the air became cooler from the evaporation of so considerable a mass of water. This effect is more especially perceptible at sunset; during the day, the shores of the rivers, covered with white sand, reflect the heat in a manner insupportable, more even than the yellowish-brown clayey grounds of Calabozo and Tisnao.

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* 42° R.

† 31·2° or 31·6° R.

On the 28th of March I was on the shore at sunrise, to measure the breadth of the Apure, which is two hundred and six toises. The thunder rolled every where around. It was the first storm, and the first rain of the season. The river was swelled by the East wind; but it soon became calm, and then some great cetaceæ, of the family of blowers, perfectly resembling the porpoises* of our seas, began to play in long files on the surface of the water. The slow and indolent crocodiles seem to dread the neighbourhood of these animals, so noisy and impetuous in their evolutions. We saw them dive whenever the *blowers* approached them. It is a very extraordinary phenomenon, to find cetaceous animals at such a distance from the coast. The Spaniards of the missions designate them, as they do the porpoises of the ocean, by the name of *toninas*. The Indian name is *orinucna* †.

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* Delphinus phocæna, L.

† In the Tamanack language.

They are three or four feet long; and bending their back, and pressing with their tail on the inferior strata of the water, they expose to view a part of the back and of the dorsal fin. I did not succeed in obtaining any, though I often engaged the Indians to shoot at them with their arrows. Father Gili asserts, that the Gumaoes eat their flesh. Are these cetaceous animals peculiar to the great rivers of South America, like the manatee, which, according to the anatomical researches of Mr. Cuvier, is also a fresh water cetaceous animal? or must we admit, that they go up from the sea against the current, as the delphinaptera beluga sometimes does in the rivers of Asia? What would lead me to doubt this last supposition is, that we saw toninas above the great cataracts of the Oroonoko, in the Rio Atapabo. Did they penetrate into the centre of equinoctial America from the mouth of the Amazon, by the communication of this river with the Rio Negro, the Cassiquiare, and the Oroonoko? They are found here at all seasons, and nothing seems to announce, that they make periodical voyages like salmon.

While the thunder rolled around us, the sky yet displayed only scattered clouds, that advanced slowly toward the zenith, and in an opposite direction. The hygrometer of Deluc was at 53°; the centigrade thermometer, 23·7°[illegible]

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* Hygrometer of Saussure, 87·5°; th. 19° R.

The electrometer, armed with a smoking match, gave no sign of electricity. As the storm gathered, the blue of the sky changed at first to deep azure, and then to gray. The vesicular vapour became visible, and the thermometer rose 3°, as is almost always the case within the tropics from a cloudy sky, that sends back the radiant heat of the soil. A heavy rain fell. Being sufficiently habituated to the climate not to fear the effect of tropical rains, we remained on the shore, to observe the electrometer. I held it more than twenty minutes in my hand, six feet above the ground, and observed, that in general the pith balls separated only a few seconds before the lightning was seen. The separation was four lines. The electric charge remained the same during several minutes; and having time to determine the nature of the electricity, by approaching a stick of sealingwax, I saw here in the plain what I have often observed on the back of the Andes during a storm, that the electricity of the atmosphere was first positive, then null, and then negative. These oscillations from positive to negative (from the vitreous to the resinous state) were often repeated. Yet the electrometer constantly denoted a little before the lightning only no E., or + E., and never — E. Toward the end of the storm, the west wind became very impetuous. The clouds dispersed, and the thermometer sunk to

22° on account of the evaporation from the soil, and the freer radiation toward the sky.

I have entered into these details on the electric charge of the atmosphere, because travellers in general have confined themselves to the description of the impressions produced on a European newly arrived by the solemn spectacle of a tropical storm. In a country, where the year is divided into two great seasons of drought and wet, or, as the Indians say in their expressive language, of Sun * and rain †, it is highly interesting to follow the progress of meteorological phenomena in the transition from one season to another. We had already observed in the valleys of Aragúa, from the 18th and 19th of February, clouds forming at the commencement of the night. In the beginning of the month of March, the accumulation of the vesicular vapours, visible to the eye, and with them signs of atmospheric electricity, augmented daily. We saw flashes of heat lightning to the South; and the electrometer of Volta displayed constantly at sunset vitreous electricity. The separation

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* In Maypure *camoti*, properly the *resplendant ardor* (of the Sun). The Tamanacs call the season of drought *uamu*, the time of *grasshoppers*.

† In the Tamanac language *canepo*. The year is designated, among several nations, by the name of one of the two seasons. The Maypures say, *so many Suns* (or rather *so many ardors of the Sun*); the Tamanacs, *so many rains*.

of the little pith balls, null during the rest of the day, was from three to four lines at the commencement of the night; which is triple what I generally observed in Europe*, with the same instrument, in calm weather. Upon the whole, from the 26th of May, the electrical equilibrium of the atmosphere seemed broken. During whole hours the electricity was null; then became very strong, from four to five lines; and soon after was again imperceptible. The hydrometer of Deluc continued to indicate great dryness from 33° to 35° †, and yet the atmosphere appeared no longer the same. Amid these perpetual variations of the electric charge of the air, the trees, divested of their foliage, already began to unfold new leaves, and seemed to feel the approach of spring.

The variations which we have just described are not peculiar to one year. Every thing in the equinoctial zone has a wonderful uniformity of succession, because the active powers of nature limit and balance each other, according to laws that are easily recognized. I shall here note the progress of atmospherical phenomena in the islands to the East of the Cordilleras of Merida and of New Grenada, in the Llanos of Venezuela and the Rio Meta, from four to ten degrees of North latitude, wherever the rains are constant from May to October, and comprehending consequently the periods of the greatest heats, which is in July and August *.

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* At Salzbourg, at Bareith, and at Jena, in Germany; in the plain of St. Denis near Paris; and on the table-land in Castille. See the table of my experiments on the electricity of the atmosphere in the *Journal de Physique*, vol. xlviii, p. 193.

† 68° to 70·8° of the hygrometer of Saussure, Reaumur's therm. from 23° to 26°; which proves the dryness of the air in the equinoctial zone.

Nothing can equal the clearness of the atmosphere from the month of December to that of February. The sky is then constantly without clouds; and if one should appear, it is a phenomenon that engages the whole attention of the inhabitants. The breeze from the East, and the East-North-East, blows with violence. As it brings with it air always of the same temperature, the vapours cannot become visible by cooling.

About the end of February and the beginning of March, the blue of the sky is less intense, the hygrometer indicates by degrees greater humidity, the stars are sometimes veiled by a slight stratum of vapours, and their light is no longer steady and planetary; they are seen twinkling

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* The maximum of the heat is felt on the coast, at Cumana, at La Guayra, and in the neighbouring island of Margaretta, not before the month of September; and the rains, if this name can be given to a few drops that fall at intervals, are observed only in the months of October and November.

from time to time at 20° above the horizon. The breeze at this period becomes less strong, less regular, and is often interrupted by *dead calms*. The clouds accumulate toward the South-South-East. They appear like distant mountains, with outlines strongly marked. From time to time they detach themselves from the horizon, and traverse the vault of the sky with a rapidity, which little corresponds with the feeble wind that reigns in the inferior strata of the air. At the end of March, the southern region of the atmosphere is illumined by small electric explosions. They are like phosphorescent gleams, circumscribed by one group of vapours. The breeze then passes from time to time, and for several hours together, to the West and South-West. This is a certain sign of the approach of the rainy season, which begins at the Oroonoko about the end of April. The sky begins to be obscured, the azure disappears, and a gray tint is spread uniformly over it. At the same time the heat of the atmosphere progressively increases; and soon they are no longer clouds, but condensed vapours, that cover the whole vault of the sky. The plaintive cry of the howling monkies begins to be heard before the rising of the Sun. The atmospheric electricity, which, during the time of great droughts, from December to March, had been constantly, in the day, from 1·7 to 2 lines on the electrometer of Volta, becomes extremely variable from the month of March. It appears null during whole days; and then for some hours the pith balls of the electrometer of Volta diverge three or four lines. The atmosphere, which is generally in the torrid, as well as in the temperate zone, in a state of vitreous electricity, passes alternately, for eight or ten minutes, to the resinous state. The season of rains is that of storms; and yet a great number of experiments, made during three years, prove to me, that it is precisely in this season of storms we find the electric tension least in the lower regions of the atmosphere. Are storms the effect of this unequal charge of the different superincumbent strata of air? What prevents the electricity from descending toward the earth, in an air become more humid since the month of March? The electricity at this period, instead of being diffused throughout the whole atmosphere, appears accumulated on the exterior envelope, at the surface of the clouds. According to Mr. Gay-Lussac it is the formation of the cloud itself, that carries the fluid toward it's surface. The storm rises in the plains two hours after the Sun has passed the meridian; consequently a short time after the moment of the maximum of diurnal heat under the tropics. It is extremely rare in the islands to hear thunder during the night, or in the morning. Storms at night are peculiar to certain vallies of rivers, that have a particular climate.

What then are the causes of this rupture of the equilibrium in the electric tension of the air? of this continual condensation of the vapours into water? of this interruption of the breezes? of this commencement and duration of the rainy seasons? I doubt whether electricity have any influence on the formation of vesicular vapours. It is rather the formation of these vapours that augments and modifies the electrical tension. To the North and to the South of the equator, storms or great explosions take place at the same time in the temperate and in the equinoctial zone. Is there an action that is propagated through the great aërial ocean from the first of these zones toward the tropics? How can it be conceived, that, under this zone, where the Sun rises constantly to so great a height above the horizon, it's passage through the zenith can have so powerful an influence on the meteorological changes? I am of opinion, that, no local cause determines the commencement of the rains under the tropics; and that a more intimate knowledge of the superior currents of air will elucidate these problems so complicated in appearance. We can observe only what passes in the lower strata of the atmosphere. The Andes are scarcely inhabited to above two thousand toises high; and at this height the proximity of the soil, and the masses of mountains, that form the shoals of the aërial ocean, have a sensible influence on the ambient air. What we observe on the table-land of Antisana is not what we should find at the same height in a balloon, hovering over the Llanos or the surface of the ocean.

We have just seen, that the season of rains and storms in the northern equinoctial zone coincides with the passage of the Sun through the zenith * of the place, with the cessation of the breezes or North-East winds, and with the frequency of calms, and *bendavales*, which are stormy winds from the South-East and South-West accompanied by a cloudy sky †. I believe, that, in reflecting on the general laws of the equilibrium of the gazeous masses that constitute our atmosphere, we find, in the interruption of the current that blows from an *homonymous* pole, in the want of the renewal of air under the torrid zone, and in the continued action of an ascending humid current, a very simple cause of the coincidence of these phenomena. While the breeze from the North-East blows with all it's violence North of the equator, it prevents the atmosphere, that covers the equinoctial lands and seas, from saturating itself with moisture. The hot and moist air of the torrid zone rises aloft, and flows off again toward the poles; while inferior polar currents, bringing drier and colder strata, are every instant taking the place of the columns of ascending air. By this constant action of two opposite currents, the humidity, far from being accumulated in the equatorial region, is carried toward the cold and temperate regions. During this season of breezes, which is that when the Sun is in the southern signs, the sky in the northern equinoctial zone is constantly serene. The vesicular vapours are not condensed, because the air, unceasingly renewed, is far from the point of saturation. In proportion as the Sun, entering the northern signs, rises toward the zenith, the breeze of the North-East softens, and by degrees entirely ceases. The difference of temperature between the tropics and the temperate northern zone is then the least possible. It is the summer of the boreal pole; and, if the mean temperature of the winter, between 42° and 52° of North latitude, be from 20° to 26° of the centigrade thermometer less than the equatorial heat, the difference in summer is scarcely from 4° to 6°. The Sun being in the zenith, and the breeze having ceased, the causes that produce humidity, and accumulate it in the northern equinoctial zone, become at once more active. The column of air, which reposes on this zone, is saturated with vapours, because it is no longer renewed by the polar current. Clouds form in this air saturated and cooled by the combined effects of radiation and the dilatation of the ascending air. This air augments it's capacity for heat in proportion as it rarifies. With the formation and collection of the vesicular vapours, the electricity accumulates in the higher regions of the atmosphere. The precipitation of the vapours is continual during the day. It generally ceases at night, and frequently even before sunset. The showers are regularly more violent, and accompanied with electric explosions, a short time after the maximum of the diurnal heat. This state of things remains the same, till the Sun enters into the southern signs. This is the commencement of cold in the northern temperate zone. The current from the North pole is then reestablished, because the difference between the heat of the equinoctial and temperate regions augments daily. The North-East breeze blows with violence, the air of the tropics is renewed, and can no longer attain the degree of saturation. The rains consequently cease, the vesicular vapour is dissolved, and the sky resumes all it's clearness and it's azure tint. Electrical explosions are no longer heard, doubtless because electricity finds no more those groups of vesicular vapours in the high regions of the air, I had almost said that coating of clouds on which the fluid can accumulate.

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* These passages take place in the fifth and tenth degrees of North lat., between the 3d and the 16th of April, and between the 27th of August and the 8th of September.

† Compare my *Essai politique sur la Nouvelle Espagne*, vol. ii, p. 382, 712, and 767.

We have here considered the cessation of the breezes as the principal cause * of the equatorial rains. These rains in each hemisphere last only as long as the Sun has a declination homonymous with that hemisphere. It is necessary to observe, that the absence of the breeze is not always succeeded by a dead calm; but that the calm is often interrupted, particularly along the western coasts of America, by *bendávales*, or South-West and South-East winds. This phenomenon seems to demonstrate, that the columns of humid air, that rise in the northern equatorial zone, sometimes flow off toward the South pole. In fact, the countries situate under the torrid zone, both North and South of the equator, furnish during their summer, while the Sun passes through their zenith, the *maximum* of difference of temperature with the air of the *heteronymous* pole. The southern temperate zone has it's winter, while it rains to the North of the equator; and while a mean heat prevails from 5° to 6° greater than in the time of drought, when the

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* I have in this discussion designedly excluded the uncertain hypotheses, founded on the combinations of oxygen and hydrogen, and on the property attributed to electricity of forming and precipitating vesicular vapours.

Sun is lower.* The continuation of the rains, while the *bendavales* blow, proves, that the currents from the remoter pole do not act in the northern equinoctial zone like the currents of the nearer pole, on account of the greater humidity of the southern polar current. The air, wafted by this current, comes from a hemisphere consisting almost entirely of water. It traverses all the southern equatorial zone to reach the parallel of 8° of North latitude; and is consequently less dry, less cold, less adapted to act as a *counter-current*, to renew the equinoctial air, and prevent it's saturation, than the northern polar current, or the breeze from the North-East †. We may suppose, that the *bendavales* are inpetuous winds on some coasts, for instance on that of Guatimala, because they are not the effect of a regular and progressive descent of the air of the tropics toward the South pole, but alternate with calms, are accompanied by electrical explosions, and are real squalls, that indicate a reflux, an abrupt and instantaneous rupture of equilibrium in the aërial ocean.

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* From the equator to 10° of North lat., the *mean* temperatures of the summer and winter months scarcely differ 2° or 3°; but at the limits of the torrid zone, toward the tropic of Cancer, the difference amounts to 8° or 9°.

† In the two temperate zones, the air loses it's transparency every time that the wind blows from the *heteronymous* pole, that is to say, from the pole that has not the same denomination as the hemisphere where the wind blows.

We have here discussed one of the most important phenomena of the meteorology of the tropics, considered in it's most general view. In the same manner as the limits of the trade-winds do not form circles parallel to the equator *, the action of the polar currents is variously felt under different meridians. The chains of mountains and the coasts in the same hemisphere have often opposite seasons. We shall hereafter have occasion to notice several examples of these anomalies; but, in order to discover the laws of nature, we must know before we examine into the causes of local perturbations, the *mean state* of the atmosphere, and the constant type of it's variations.

The aspect of the sky, the progress of the electricity, and the shower of the 28th of March, announced the commencement of the rainy season; we were still advised however, to go from San Fernando de Apure by San Francisco de Capanaparo, the Rio Sinaruco, and the *Hato* de San Antonio, to the village of the Otomacks, recently founded near the banks of the Meta, and to embark on the Oroonoko a little above Carichana. This way by land lies across an unhealthy and feverous country. An old farmer, Don Francisco Sanchez, obligingly offered to conduct us. His dress denoted the great simplicity of manners, that prevails in those distant countries. He had acquired a fortune of more than 100,000 piastres, and yet he mounted on horseback with bare feet, armed with large silver spurs. We knew by the experience of several weeks the dull uniformity of the vegetation of the Llanos, and preferred the longer road, that leads by the Rio Apure to the Oroonoko. We chose one of those very large canoes, called *lanchas* by the Spaniards[*]. A pilot[†] and four Indians were sufficient to manage it. They constructed near the stern, in the space of a few hours, a cabin covered with the leaves of the corypha, sufficiently spacious to contain a table and benches. These were made of ox hides, strained tight, and nailed to frames of brazil wood. I mention these minute circumstances, to prove that our accommodations on the Rio Apure were far different from those, to which we were reduced in the narrow boats of the Oroonoko. We loaded the canoe with provision for a month. Fowls, eggs, plantains, cassava, and cacao, are found in abundance at

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* See above, vol. ii, p. 3 and 72; and my *Mémoire sur les lignes isothermes*, p. 114.

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[*] We payed for the conveyance from San Fernando de Apure to Carichana on the Oroonoko, a distance that takes eight days, ten piastres for the *lancha*, beside the price of the days' works, which is half a piastre, or four *rials*, for the pilot, and two *rials* for every Indian rower.

[†] *El patron.*

San Fernando. The good capuchin [*] father gave us sherry wine, oranges, and tamarinds, to make cooling beverages. We could foresee, that a roof constructed of palm-tree leaves would become excessively heated in the bed of a large river, where we were almost always exposed to the perpendicular rays of the Sun. The Indians relied less on the provision we had purchased, than on their hooks and nets. We took also some firearms, which we found in pretty general use as far as the cataracts; but farther South the immense humidity of the air prevents the missionaries from using musquets. The Rio Apure abounds in fish, manatees, and turtles, the eggs of which afford an aliment more nutritious than agreeable to the taste. It's banks are peopled by an innumerable quantity of birds, among which the *pauxi* and the *guacharaca*, which may be called the turkeys and pheasants of those countries, are found the most useful. Their flesh appeared to be harder and less white than that of our gallinaceous tribe in Europe, because they use much more muscular exercise [†]. We did not forget to add to our provision, fishing-instruments, and fire-arms, a few casks of brandy, to serve as a medium of barter with the Indians of the Oroonoko.

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[*] Fray Jose Maria de Malaga.

[†] The muscular contraction (the discharge from the nerve into the muscle) is attended with a chemical change in the elements. There is an absorption of oxygen from the arterial blood, and, during this absorption, the muscular fibre blackens, and becomes carbonized.

We departed from San Fernando[*] on the 30th of March, at four in the afternoon. The weather was extremely hot; the thermometer rising in the shade to 34°, though the breeze blew very strongly from the South-East. Owing to this contrary wind we could not set our sails. We were accompanied in the whole of this voyage on the Apure, the Oroonoko, and the Rio Negro, by the brother-in-law of the governor of the province of Varinas, Don Nicolas Sotto, who, recently arrived from Cadiz, had made an excursion to San Fernando. Desirous of visiting countries so calculated to excite the curiosity of a European, he did not hesitate to confine himself with us during seventy-four days in a narrow boat, infested with moschettoes.

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[*] I found, by meridian altitudes of α in the Southern Cross, the latitude of San Fernando de Apure (at the house of the missionary) 7° 53′ 12″. (*Obs. Ast.*, vol. i, p. 216.) The longitude by the timekeeper was 70° 21′ 10″; the dip of the needle, 36·71°, cent. div. The intensity of magnetic action manifested itself, as at Calabozo, by two hundred and twenty-two oscillations in 10′. The name of San Fernando is not yet found on modern maps, for instance on the fine maps of Arrowsmith and Brué, notwithstanding the astronomical position of this town was published twelve years ago in my *Conspectus Longitudinum et Latitudinum Americæ æquinoctialis.*

His amiable disposition and gay temper often contributed to make us forget the sufferings of a voyage, that was not wholly exempt from danger. We passed the mouth of the Apurito, and coasted the island of the same name, formed by the Apure and the Guarico. This island is in fact only a very low spot of ground, bordered by two great rivers, both of which at a little distance from each other fall into the Oroonoko, after having formed a junction below San Fernando by the first bifurcation of the Apure. *L'Isla* del Apurito is twenty-two leagues in length, and two or three leagues in breadth. It is divided by the *Cano* de la Tigrera, and the *Cano* del Manati, into three parts; the two extremes of which bear the names of Isla de Blanco, and Isla de los Garzitas. I enter into these particulars, because all the maps hitherto published disfigure in the strongest manner the course and branches of the rivers between the Guarico and the Meta. The right bank of the Apure, below the Apurito, is somewhat better cultivated than the left bank, where the Yaruroes (or Japuin Indians) have constructed a few huts with reeds and stalks of palm-leaves. They live by hunting and fishing; and being very skilful in killing jaguars, it is they who principally carry the skins, known in Europe by the name of tiger-skins, to the Spanish villages. A part of these Indians have been baptized, but they never visit the Christian churches. They are considered as savages, because they choose to remain independant. Other tribes of Yaruroes live under the rule of the missionaries, in the village of Achaguas, situate to the South of the Rio Payara. The individuals of this nation, whom I had an opportunity of seeing at the Oroonoko, have some features in their physiognomy that are erroneously called Tatarian, and which belong to branches of the Mongul race. Their look is stern, the eye very long, high cheekbones, but the nose prominent throughout it's whole length. They are taller, browner, and less thick-set than the Chayma Indians. The missionaries praise the intellectual character of the Yaruroes, who were formerly a powerful and numerous nation on the banks of the Oroonoko, especially in the environs of Caycara, below the mouth of the Guarico. We passed the night at *Diamante*, a small sugar plantation formed opposite the island of the same name.

During the whole of my voyage from San Fernando to San Carlos del Rio Negro, and thence to the town of Angostura, I confined myself to writing day by day, either in the boat, or where we disembarked at night, what appeared to me worthy of observation. Violent rains, and the prodigious quantity of moschettoes with which the air is filled on the banks of the Oroonoko and the Cassiquiare, necessarily occasioned some breaks in this labour; which I supplied by notes taken a few days after. The following pages are extracts from my journal. Whatever is written while the objects we describe are before our eyes bears a character of truth, I had almost said of individuality, which gives attraction to things the least important.

In order to avoid useless repetitions, I have sometimes added to this journal the notions I afterward acquired respecting the objects I had described. The more nature appears great and awful in forests traversed by immense rivers, the more we should preserve in our pictures of the scenery that character of simplicity, which constitutes the principal and often the sole merit of a first sketch.

March the 31st. A contrary wind obliged us to remain on shore till noon. We saw a part of some canefields laid waste by the effect of a conflagration, which had spread from a neighbouring forest. The wandering Indians every where set fire to the forest where they have encamped at night; and during the season of drought, vast provinces would be the prey of these conflagrations, if the extreme hardness of the wood did not prevent the trees from being entirely consumed. We found trunks of desmanthus, and mahogany *(cahoba)*, that were scarcely charred two inches deep.

Having passed the Diamante, we entered a land inhabited only by tigers, crocodiles, and *chiguires*, a large species of the genus cavia of Linneus. We saw flocks of birds, crowded so close together, as to appear against the sky like a dark cloud, that every instant changed it's form. The river widens by degrees. One of it's banks is generally barren and sandy from the effect of inundations: the other is higher, and covered with lofty trees. Sometimes the river is bordered by forests on each side, and forms a straight canal a hundred and fifty toises broad. The manner in which the trees are disposed is very remarkable. We first find bushes of *sauso* *, forming a kind of hedge four feet high; and appearing as if they had been clipped by the hand of man. A copse of cedars, brazillettoes, and lignum vitæ, rises behind this hedge. Palm-trees are rare; we saw only a few scattered trunks of the thorny piritu and corozo. The large quadrupeds of those regions, the tigers, tapirs, and pecaris, have made openings in the hedge of *sausos* which we have just described. Through these the wild animals pass, when they come to drink at the river. As they fear but little the approach of a boat, we had the pleasure of viewing them pace slowly along the shore, till they disappeared in the forest, which they entered by one of the narrow passes left here and there between the bushes. I confess that these scenes, which were often repeated, had ever for me a peculiar attraction. The pleasure they excite is not owing solely to the interest, which the naturalist takes in the objects of his study; it is connected with a feeling common to all men, who have been brought up in the habits of civilization. You find yourself in a new world, in the midst of untamed and savage nature. Now it is the jaguar, the beautiful panther of America, that appears upon the shore; and now the hocco* with it's black plumage and it's tufted head, that moves slowly along the sausoes. Animals of the most different classes succeed each other. "*Esse como en el Paraiso* †," said our pilot, an old Indian of the missions. Every thing indeed here recalls to mind that state of the primitive world, the innocence and felicity of which ancient and venerable traditions have transmitted to all nations: but, in carefully observing the manners of animals between themselves, we see that they mutually avoid and fear each other. The golden age has ceased; and in this Paradise of the American forests, as well as every where else, sad and long experience has taught all beings, that benignity is seldom found in alliance with strength.

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* Hermesia castaneifolia. This is a new genus, approaching the alchornea of Swartz. (See our *Plantæ Equinox.*, vol. i, p. 163, pl. xlvi.)

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* Crax alector, the peacock pheasant; c. pauxi, the cashew bird.

† "It is just as it was in Paradise."

When the shore is of considerable breadth, the hedge of *sauso* remains at a distance from the river. In this intermediate ground we see crocodiles, sometimes to the number of eight or ten, stretched on the sand. Motionless, the jaws opened at right angles, they repose by each other without displaying any of those marks of affection, observed in other animals that live in society. The troop separates as soon as they quit the shore. It is, however, probably composed of one male only, and many females; for, as Mr. Descourtils, who has so much studied the crocodiles of Saint Domingo, observed before me, the males are rare, because they kill one another in fighting during the season of their loves. These monstrous reptiles are so numerous, that throughout the whole course of the river we had almost at every instant five or six in view. Yet at this period the swelling of the Rio Apure was scarcely perceived; and consequently hundreds of crocodiles were still buried in the mud of the savannahs. About four in the afternoon we stopped to measure a dead crocodile, that the waters had thrown on the shore. It was only sixteen feet eight inches long; some days after Mr. Bonpland found another, a male, twenty-two feet three inches long. In every zone, in America as in Egypt, this animal attains the same size. The species so abundant in the Apure, the Oroonoko *, and the Rio de la Magdalena, is not a *çayman*, or alligator, but a real crocodile, with feet dentated at the external edges, analogous to that of the Nile. When it is recollected, that the male enters the age of puberty only at ten years, and that it's length is then eight feet, we may presume, that the crocodile measured by Mr. Bonpland was at least twenty-eight years old. The Indians told us, that at San Fernando scarcely a year passes, without two or three grown up persons, particularly women who fetch water from the river, being drowned by these carnivorous lizards. They related to us the history of a young girl of Uritucu, who by singular intrepidity and presence of mind, saved herself from the jaws of a crocodile. When she felt herself seized, she sought the eyes of the animal, and plunged her fingers into them with such violence, that the pain forced the crocodile to let her loose, after having bitten off the lower part of her left arm. The girl, notwithstanding the enormous quantity of blood she lost, happily reached the shore, swimming with the hand she had still left. In those desert countries, where man is ever wrestling with nature, discourse daily turns on the means, that may be employed to escape from a tiger, a boa or *traga venado*, or a crocodile; every one prepares himself in some sort for the dangers that await him. I knew, said the young girl of Urituca coolly, "that the *cayman* lets go his hold, if you push your fingers into his eyes." Long after my return to Europe I learned, that in the interior of Africa the Negroes know and practise the same means. Who does not recollect with a lively interest *Isaaco*, the guide of the unfortunate Mungo Park, seized twice, near Boulinkombou *, by a crocodile, and twice escaping from the jaws of the monster, having succeeded in placing his fingers under water in both his eyes? The African Isaaco, and the young American, owed their safety to the same presence of mind, and the same combination of ideas.

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* It is the *arua* of the Tamanack Indians, the *amana* of the Maypure Indians, the crocodilus acutus of Mr. Cuvier.

The movements of the crocodile of the Apure are abrupt and rapid when it attacks any object; but it moves with the slowness of a salamander, when it is not excited by rage or hunger. The animal in running makes a rustling noise, that seems to proceed from the rubbing of the scales of it's skin against one another. In this movement it bends it's back, and appears higher on it's legs than when at rest. We often heard this noise of the scales very near us on the shore; but it is not true, as the Indians pretend, that, like the pangolins, the old crocodiles "can erect their scales, and every part of their armour." The motion of these animals is no doubt generally in a straight line, or rather like that of an arrow which changes it's direction at certain distances. However, notwithstanding the little apparatus of false ribs, that connects the vetebræ of the neck, and seems to impede the lateral movement, crocodiles can turn easily when they please. I often saw young ones biting their tails; and other observers have seen the same action in crocodiles at their full growth. If their movements almost always appear to be straight forward, it is because, like our small lizards, they execute them by starts. Crocodiles are excellent swimmers; they go with facility against the most rapid current. It appeared to me, however, that in descending the river they had some difficulty in turning quickly about. A large dog, that had accompanied us in our journey from Caraccas to the Rio Negro, was one day pursued in swimming by an enormous crocodile, which had nearly reached him, when the dog escaped it's enemy by turning round suddenly and swimming against the current. The crocodile performed the same movement, but much more slowly than the dog, which happily gained the shore.

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* Mungo Park's last Travels in Africa, 1815, p. 89.

The crocodiles of the Apure find abundant nourishment in the chiguires[*] (the thick-nosed tapir of naturalists), which live fifty or sixty together in troops on the banks of the river. These unfortunate animals, as large as our pigs, have no weapons of defence; they swim somewhat better than they run: yet they become the prey of the crocodiles in the water, as of the tigers on land. It is difficult to conceive, how, persecuted by two powerful enemies, they can become so numerous; but they breed with the same rapidity as the cobayas, or little guinea-pigs, which come to us from Brazil.

We stopped below the mouth of the Cano de la Tigrera, in a sinuosity called *la Vuelta del Joval*, to measure the velocity of the water at it's surface. It was not more than 3·2 feet[*] in a second; which gives 2·56 feet for the *mean* velocity. The barometrical heights, attending to the effects of the little horary variations, indicated scarcely a slope of seventeen inches in a mile of nine hundred and fifty toises. The velocity is the simultaneous effect of the slope of the ground, and the accumulation of the waters by the swelling of the upper parts of the river. We were again surrounded by chiguires, which swim like dogs, raising the head and neck above the water. We saw with surprise a large crocodile on the opposite shore, motionless, and sleeping in the midst of these nibbling animals. It awoke at the approach of our canoe, and went into the water slowly, without affrighting the chiguires. Our Indians accounted for this indifference by the stupidity of the animal; but it is more probable, that the chiguires know by long experience, that the crocodile of the Apure and the Oroonoko does not attack upon land, unless he finds the object he would seize immediately in his way, at the instant when he throws himself into the water.

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[*] Cavia capybara, Lin. The word *chiguire* belongs to the language of the Palenkas and the Cumanagotoes. (See chap. ix, vol. iii, p. 283.) The Spaniards call this animal *guardatinaja;* the Caribbees, *capigua;* the Tamanacks, *cappiva;* the Maypures, *chiato.* According to Azzara, it is known at Buenos Ayres by the Indian names of *capiyguà* and *capiguara.* These various denominations display a striking analogy between the languages of the Oroonoko, and those of the Rio de la Plata.

† In order to measure the velocity of the surface of rivers, I generally measured on the beach a basis of 250 feet, and observed with the chronometer the time, that a floating body abandoned to the current required, to reach this distance.

Near the *Joval* nature assumes an awful and savage aspect. We there saw the largest tiger we had ever met with. The natives themselves were astonished at it's prodigious length, which surpassed that of all the tigers of India I had seen in the collections of Europe. The animal lay stretched beneath the shade of a large zamang*.

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* A species of mimosa.

It had just killed a chiguire, but had not yet touched it's prey, on which it kept one of it's paws. The zamuroes, a species of vulture which we have compared above to the percnopterus of Lower-Egypt, were assembled in flocks to devour the remains of the jaguar's repast. They afforded the most curious spectacle, by a singular mixture of boldness and timidity. They advanced within the distance of two feet from the jaguar, but at the least movement the beast made they drew back. In order to observe more nearly the manners of these animals, we went into the little boat, that accompanied our canoe. Tigers very rarely attack boats by swimming to them; and never but when their ferocity is heightened by a long privation of food. The noise of our oars led the animal to rise slowly, and hide itself behind the *sauso* bushes, that bordered the shore. The vultures tried to profit by this moment of absence to devour the chiguire: but the tiger, notwithstanding the proximity of our boat, leaped into the midst of them; and in a fit of rage, expressed by his gait and the movement of his tail, carried off his prey to the forest. The Indians regretted, that they were not provided with their lances, in order to go on shore, and attack the tiger. They are accustomed to this weapon, and were right in not trusting to our musquets, which, in an air so excessively humid, often miss fire.

Continuing to descend the river, we met with the great herd of chiguires, which the tiger had put to flight, and from which he had selected his prey. These animals saw us land with great tranquillity; some of them were seated, and gazed upon us, moving the upper lip like rabbits. They seemed not to be afraid of men, but the sight of our great dog put them to flight. Their hind legs being longer than their fore legs, their pace is a slight gallop, but with so little swiftness, that we succeeded in catching two of them. The chiguire, which swims with the greatest agility, utters a short moan in running, as if it's respiration were impeded. It is the largest of the family of gnawing animals. It defends itself only at the last extremity, when it is surrounded and wounded. Having great strength in it's grinding teeth *, particularly the hinder ones, which are pretty long, it can tear the paw of a tiger, or the leg of a horse, with it's bite. It's flesh has a smell of musk somewhat disagreeable; yet hams are made of it in this country, which almost justifies the name of

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* We reckoned eighteen on each side. On the hind feet, at the upper end of the metatarsus, there is a callosity three inches long and three quarters of an inch broad, destitute of hair. The animal when seated rests upon this part. No tail is visible externally; but on putting aside the hair we discover a tubercle, a mass of naked and wrinkled flesh, of a conical figure, and half an inch long.

water hog, given to the chiguire by some of the older naturalists. The missionary monks do not hesitate to eat these hams during Lent. According to their zoological classification, they place the armadillo, the thick-nosed tapir, and the manatee, near the tortoises; the first, because it is covered with a hard armour, like a sort of shell; and the others because they are amphibious. The chiguires are found in such numbers on the banks of the rivers Santo Domingo, Apure, and Arauca, in the marshes and the inundated savannahs * of the Llanos, that the pasturages suffer from them. They browze the grass which fattens the horses best, and which bears the name of *chiguirero*, "chiguire grass." They feed also upon fish; and we saw with surprise, that, affrighted by the approach of a boat, the animal in diving remains eight or ten minutes under water.

We passed the night as usual, in the open air, though in a *plantation*, the proprietor of which employed himself in hunting tigers. He was almost naked, and of a dark brown complexion like a Zambo. This did not prevent his thinking himself of the cast of Whites. He called his wife and his daughter, who were as naked as himself, donna Isabella, and donna Manuela. Without having ever quitted the banks of the Apure, he took a lively interest "in the news of Madrid, in those wars which never ended, and in every thing down yonder; *todas las cosas de alla*." He knew, that the king was soon to come and visit "the grandees of the country of Caraccas," but, added he with some pleasantry, "as the people of the court can eat only wheaten bread, they will never pass beyond the town of Victoria, and we shall not see them here." I had brought with me a chiguire, which I had intended to have roasted; but our host assured us, that such "Indian game" was not food fit for *nos otros cavalleros blancos*, "white gentlemen like him and me." Accordingly he offered us some venison, which he had killed the day before with an arrow, for he had neither powder nor firearms.

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* Near Urituca, in the *Cano* del Ravanal, we saw a drove of 80 or 100 of these animals.

We supposed, that a small wood of plantain trees concealed from us the hut of the farm: but this man, so proud of his nobility and the colour of his skin, had not taken the trouble of constructing an *ajoupa* of palm-leaves. He invited us to have our hammocks hung near his own, between two trees; and he assured us with an air of complacency, that, if we came up the river in the rainy season, we should find him beneath a roof*. We soon had reason to complain of a philosophy, which, indulgent to indolence, renders a man indifferent to the conveniences of life. A furious wind arose after midnight, lightnings ploughed the horizon, the thunder rolled, and we were wet to the skin. During this storm a whimsical incident served to amuse us for a moment. Donna Isabella's cat had perched upon the tamarind-tree, at the foot of which we lay. It fell into the hammock of one of our companions, who, wounded by the claws of the cat, and awakened from a profound sleep, thought he was attacked by some wild beast of the forest. We ran to him on hearing his cries, and had some trouble to convince him of his error. While it rained in torrents on our hammocks, and the instruments we had landed, don Ignacio congratulated us on our good fortune in not sleeping on the strand, but finding ourselves in his domain, among Whites and persons of rank; *entre gente blanca y de trato.* Wet as we were, we could not easily persuade ourselves of the advantages of our situation, and listened with some impatience to the long narrative our host gave us of his pretended expedition to Rio Meta, of the valour he had displayed in a bloody combat with the Guahibo Indians, and "the services that he had rendered to God and his king, in carrying away children *(los Indiecitos)* from their parents, to distribute them in the missions." How singular a spectacle, to find in that vast solitude a man, who believes himself of European race, and knows no other shelter than the shade of a tree, with all the vain pretensions, all the hereditary prejudices, all the errors, of long civilization!

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* *Baxo techo.*

April the 1st. At sunrise we quitted signior don Ignacio, and signora donna Isabella his wife. The weather was cooler, for the thermometer, which generally kept up in the day to 30° or 35°, had sunk to 24°. The temperature of the river was little changed, it continued constantly at 26° or 27°. The current carried with it an enormous quantity of trunks of trees. We might imagine, that on ground entirely smooth, and where the eye cannot distinguish the least hill, the river would have formed by the force of it's current a channel in a straight line. A glance at the map, which I traced by the compass, will prove the contrary. The two banks, worn by the waters, do not furnish an equal resistance; and almost imperceptible inequalities of the level suffice to produce great sinuosities. Yet below the Joval, where the bed of the river enlarges a little, it forms a channel that appears perfectly straight, and is shaded on each side by very tall trees. This part of the river is called *Cano Ricco.* I found it to be one hundred and thirty-six toises broad. We passed a low island, inhabited by thousands of flamingoes, rose-coloured spoonbills herons, and moorhens, which displayed a mixture of the most various colours. These birds were so close together, that they seemed to be unable to stir. The island they inhabit is called *Isla de Aves*. Lower down we passed the point, where the Rio Arichuna, an arm of the Apure, branches off to the Cabulare, carrying off a considerable body of it's waters. We stopped on the right bank, at a little Indian mission, inhabited by the tribe of the Guamoes. There were yet only sixteen or eighteen huts constructed with the leaves of the palm-tree; yet, in the statistical tables presented annually by the missionaries to the court, this assemblage of huts is marked with the name of the *village de Santa Barbara de Arichuna*.

The Guamoes * are a race of Indians very difficult to fix on a settled spot. They have great similiarity of manners with the Achaguas, the Guajiboes †, and the Otomacoes, partaking their disregard of cleanliness, their spirit of vengeance, and their taste for wandering; but their language differs essentially. The greater part of these four tribes live by fishing and hunting, in plains often inundated, and situate between the Apure, the Meta, and the Guaviare. The nature of these regions seems to invite the nations to a wandering life. On entering *the mountains of the Cataracts* of the Oroonoko, we shall soon find among the *Piraoas,* the *Macoes,* and the *Maquiritares,* milder manners, the love of agriculture, and great cleanliness in the interior of their huts. On the backs of mountains, in the midst of impenetrable forests, man is compelled to fix himself, and cultivate a small spot of land. This cultivation requires little care; while in a country where there are no other roads than rivers, the life of the hunter is laborious and difficult. The Guamoes of the mission of Santa Barbara could not furnish us with the provision we wanted. They cultivate only a little cassava. They appeared hospitable; and, when we entered their huts, offered us dried fish and water (in their tongue *cub).* This water was cooled in porous vessels.

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* Father Gili asserts, that their Indian name is *Uamu* and *Pau*, and that they originally dwelt on the Upper Apure.

† Their Indian name is *Guaiva*, pronounced *Guahiva*.

Beyond the *Vuelta del Cochino roto,* in a spot where the river has scooped itself a new bed, we passed the night on a bare and very extensive strand. The forest being impenetrable, we had the greatest difficulty to find dry wood to light fires, near which the Indians believe themselves in safety from the nocturnal attacks of the tiger. Our own experience seems to depose in favour of this opinion; but M. d'Azzara asserts, that in his time a tiger in Paraguay carried off a man, who was seated near a fire lighted in the savannah.

The night was calm and serene, and there was a beautiful moonlight. The crocodiles were stretched along the shore. They placed themselves in such a manner as to be able to see the fire. We thought we observed, that it's splendour attracted them, as it attracts fishes, crayfish, and other inhabitants of the water. The Indians showed us the traces of three tigers in the sand, two of which were very young. A female had no doubt conducted her little ones to drink at the river. Finding no tree on the strand, we stuck our oars in the ground, and to these we fastened our hammocks. Every thing passed tranquilly till eleven at night; and then a noise so terrific arose in the neighbouring forest, that it was almost impossible to close our eyes. Amid the cries of so many wild beasts howling at once, the Indians discriminated such only as were heard separately. These were the little soft cries of the sapajous, the moans of the alouates, the howlings of the tiger, the couguar, or American lion without mane, the pecari, and the sloth, and the voices of the curassoa, the parraka, and some other gallinaceous birds. When the jaguars approached the skirt of the forest, our dog, which till then had never ceased barking, began to howl and seek for shelter beneath our hammocks. Sometimes, after a long silence, the cry of the tiger came from the tops of the trees; and in this case it was followed by the sharp and long whistling of the monkeys, which appeared to flee from the danger that threatened them.

I notice every circumstance of these nocturnal scenes, because, being recently embarked on the Rio Apure, we were not yet accustomed to them. We heard the same noises repeated, during the course of whole months, whenever the forest approached the bed of the rivers. The security displayed by the Indians inspires travellers with confidence. You persuade yourself with them, that the tigers are afraid of fire, and do not attack a man lying in his hammock. These attacks are in fact extremely rare; and, during a long abode in South America, I remember only one example of a Llanero, who was found torn in his hammock opposite the island of Achaguas.

When the natives are interrogated on the causes of this tremendous noise made by the beasts of the forest at certain hours of the night, they reply gaily, "they are keeping the feast of the full moon."

I believe this agitation is most frequently the effect of some contest, that has arisen in the depths of the forest. The jaguars, for instance, pursue the pecaris and the tapirs, which, having no defence but in their numbers, flee in close troops, and break down the bushes they find in their way. Affrighted at this struggle, the timid and mistrustful monkies answer from the tops of the trees the cries of the large animals. They awaken the birds that live in society, and by degrees the whole assembly is in movement. We shall soon find, that it is not always in a fine moonlight, but more particularly at the time of a storm and violent showers, that this tumult takes place among the wild beasts. "May Heaven grant them a quiet night and repose, and us also!" said the monk who accompanied us to the Rio Negro, when, sinking with fatigue, he assisted in arranging our accommodations for the night. It was indeed a strange situation, to find no silence in the solitude of woods. In the inns of Spain we dread the sharp sounds of guitars from the next apartment; in those of the Oroonoko, which are an open beach, or the shelter of a solitary tree, we are afraid of being disturbed in our sleep by voices issuing from the forest.

April the 2d. We set sail before sunrise. The morning was beautiful and cool, according to the feelings of those, who are accustomed to the heats of these climates. The thermometer rose to 28° only in the air; but the dry and white sand of the beach, notwithstanding it's radiation toward a sky without a cloud, retained a temperature of 36°. The porpoises *(toninas)* ploughed the river in long files. The shore was covered with fishing birds. Some of these embarked on the floating wood, that passed down the river, and surprised the fish that preferred the middle of the stream. Our canoe touched several times during the morning. These shocks, when violent, are capable of splitting a light bark. We struck on the points of several large trees, which remain for years in an oblique position, sunk in the mud. These trees descend from Sarare, at the period of great inundations. These so fill the bed of the river, that canoes in going up find it difficult sometimes to make their way over the shoals, or wherever there are eddies. We reached a spot near the island of Carizales, where we saw trunks of the locust-tree of an enormous size above the surface of the water. They were covered with a species of plotus, nearly approaching the *anhinga*, or white bellied darter. These birds perch in files, like pheasants and parrakas. They remain for hours entirely motionless, with the beak raised toward the sky, which gives them a singular air of stupidity.

Below the island of Carizales we observed a diminution of the waters of the river, at which we were so much the more surprised, as, after the bifurcation at *la Boca de Arichuna*, there is no branch, no natural drain, that takes away water from the Apure. The loss is solely the effect of evaporation, and of filtration on a sandy and wet shore. We may form an idea of the magnitude of these effects, when we recollect, that we found the heat of the dry sands, at different hours of the day, from 36° to 52°, and that of sands covered with three or four inches of water 32°. The beds of rivers are heated as far as the depth, to which the solar rays can penetrate without having undergone too great an extinction in their passage through the superincumbent strata of water. Besides, the effect of filtration extends far beyond the bed of the river; it may be said to be lateral. The shore, which appears dry to us, imbibes water as far as the level of the surface of the river. We saw water gush out at the distance of fifty toises from the shore, every time that the Indians stuck their oars into the ground; now these sands, wet underneath, but dry above, and exposed to the solar rays, act like a sponge. They are losing the infiltrated water every instant by evaporation. The vapour, that is emitted, traverses the upper stratum of sand strongly heated, and becomes sensible to the eye, when the air cools toward the evening. As the beach dries, it draws from the rivers new portions of water; and it may be considered, that this continual alternation of vaporization and lateral *imbibition* must cause an immense loss, difficult to submit to exact calculation. The increase of these losses would be in proportion to the length of the course of the rivers, if from their source to their mouth they were equally surrounded by a flat shore; but these shores being formed by depositions from the water, and the water having less velocity in proportion as it is more remote from it's source, deposing necessarily more in the lower than in the upper part of it's course, many rivers of hot climates undergo a diminution in the quantity of their water, as they approach their mouth. Mr. Barrow has observed these curious effects of sands in the southern part of Africa, on the banks of Orange river. They are even become the subject of a very important discussion, in the various hypotheses that have been formed on the course of the Niger.

Near the *Vuelta de Basilio*, where we landed to collect plants, we saw on the top of a tree two beautiful little monkies, black as jet, of the size of the sai, with *prehensile* tails. Their physiognomy and their movements sufficiently showed, that they were neither the quato [*simia beelzebub*, L.], nor the chamek, nor any of the *ateles*. Our Indians themselves had never seen any that resembled them. These forests abound in sapajous unknown to the naturalists of Europe; and as monkeys, especially those that live in troops, and for this reason are [illegible] enterprising, make long emigrations at certain periods, it happens, that at the beginning of the rainy season the natives discover round their huts different kinds, which they had never before observed. On this same bank, our guides showed us a nest of young iguanas, that were only four inches long. It was difficult to distinguish them from a common lizard. There was nothing yet formed but the dewlap below the throat. The dorsal spines, the large erect scales, all those appendages, that render the iguana so monstrous when it attains the length of three or four feet, were scarcely traced.

The flesh of this animal of the *saurien* family appeared to us to have an agreeable taste in every country, where the climate is very dry; we even found it so at periods when we were not in want of other food. It is extremely white, and next to the flesh of the armadillo, here called *cachicamo*, one of the best eatables to be found in the huts of the natives.

It rained toward the evening. Before the rain fell, swallows, exactly resembling our own, skimmed over the surface of the water. We saw also a flock of paroquets pursued by little goshawks without crests. The piercing cries of these paroquets contrasted singularly with the whistling of the birds of prey. We passed the night in the open air, upon the beach, near the island of Carizales. There were several Indian huts in the neighbourhood, surrounded with plantations. Our pilots assured us beforehand, that we should not hear the cries of the jaguar, which, when not extremely pressed by hunger, withdraws from places where he does not rule alone. “Men put him out of humour,” *los hombres lo enfadan*, say the people in the missions. A pleasant, and simple expression, that marks a well-observed fact.

April the 3d. Since our departure from San Fernando we have not met a single boat on this fine river. Every thing denotes the most profound solitude. In the morning our Indians caught with a hook the fish known in the country by the name of *caribe*, or *caribito*, because no other fish has such a thirst for blood. It attacks bathers and swimmers, from whom it often carries away considerable pieces of flesh. When a person is only slightly wounded, it is difficult for him to get out of the water without receiving a severer wound. The Indians dread extremely these caribes; and several of them showed us the scars of deep wounds in the calf of the leg, and in the thigh, made by these little animals, which the Maypures call *umati*. They live at the bottom of rivers; but if a few drops of blood be shed on the water, they arrive by thousands at the surface. When we reflect on the number of these fish, the most voracious and cruel of which are only four or five inches long; on the triangular form of their sharp and cutting teeth, and on the amplitude of their *retractile* mouth, we need not be surprised at the fear which the caribe excites in the inhabitants of the banks of the

Apure and the Oroonoko. In places where the river was very limpid, and where not a fish appeared, we threw into the water little morsels of flesh covered with blood. In a few minutes a cloud of caribes came to dispute the prey. The belly of this fish has a cutting edge, indented like a saw; a character that may be traced in several kinds, the *serra-salmes*, the *myletes*, and the *pristigastrés*. The presence of a second adipous dorsal fin; and the form of the teeth, covered by lips distant from each other, and largest in the lower jaw; place the *caribe* among the *serra-salmes*. It's mouth is much wider than that of the *myletes* of Mr. Cuvier. It's body toward the back is ash-coloured, with a tint of green; but the belly, the gill-covers, and the pectoral, anal, and ventral fins, are of a fine orange. Three species (or varieties) are known in the Oroonoko, and are distinguished by their size. The *méan*, or intermediate, appears to be identical with the *mean* species of the piraya, or piranha, of Marcgrav[*]. I described and drew[†] it on the spot. The caribito has a very agreeable taste. As no one dares to bathe where it is found, it may be considered as one of the greatest scourges of those climates, in which the sting of the moschettoes, and the irritation of the skin, render the use of baths so necessary.

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[*] Salmo rhombeus, Lin.

[†] See the memoir on the fishes of Equinoctial America, which I published conjointly with Mr. Valenciennes, in the *Observ. de Zoologie*, vol. ii, p. 145.

We stopped at noon in a desert spot called *Algodonal.* I left my companions, while they drew the boat to land, and were occupied in preparing our dinner. I went along the beach to observe nearer a group of crocodiles sleeping in the Sun, and placed in such a manner, as to have their tails, furnished with broad plates, resting on one another. Some little herons *, white as snow, walked along their backs, and even upon their heads, as if they were passing over trunks of trees. The crocodiles were of a greenish-gray, half covered with dried mud; from their colour and immobility they might have been taken for statues of bronze.. This excursion had nearly proved fatal to me. I had kept my eyes constantly turned toward the river; but, on picking up some spangles of mica agglomerated together in the sand, I discovered the recent footsteps of a tiger, easily distinguishable from their form and size. The animal had gone toward the forest; and turning my eyes on that side, I found myself within eighty steps of a jaguar, lying under the thick foliage of a ceiba. No tiger had ever appeared to me so large.

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* *Garzon chico.* It is believed in Upper Egypt, that the herons have an affection for the crocodile, because they take advantage in fishing of the terror, that this monstrous animal causes among the fishes, which he drives from the bottom to the surface of the water; but on the banks of the Nile, the heron keeps prudently at some distance from the crocodile. (Geoffroy de St. Hilaire, in the *Ann. du Musée,* vol. ix, p. 384.)

There are accidents in life, against which we might seek in vain to fortify our reason. I was extremely frightened, yet sufficiently master of myself, and of my motions, to enable me to follow the advice which the Indians had so often given us, how to act in such cases. I continued to walk on without running; avoided moving my arms; and thought I observed that the jaguar's attention was fixed on a herd of *capybaras*, which were crossing the river. I then began to return, making a large circuit toward the edge of the water. As the distance increased, I thought I might accelerate my pace. How often was I tempted to look back, in order to assure myself that I was not pursued! Happily I yielded very tardily to this desire. The jaguar had remained motionless. These enormous cats with spotted robes are so well fed in countries abounding in *capybaras*, *pecaris*, and deer, that they rarely attack men. I arrived at the boat out of breath, and related my adventure to the Indians. They appeared very little moved by it; yet, after having loaded our firelocks, they accompanied us to the ceiba, beneath which the jaguar had lain. He was there no longer, and it would have been imprudent to have pursued him into the forest, where we must have dispersed, or marched in file, amid intertwining lianas.

In the evening we passed the mouth of the *Cano del Manati*, thus named on account of the immense quantity of manatees caught there every year. This herbivorous animal of the cetaceous family, called by the Indians *apcia* and *avia* *, attains here generally ten or twelve feet in length. It weighs from five hundred to eight hundred pounds †. We saw the water covered with it's excrements, which are very fetid, but perfectly resembling those of an ox. It abounds in the Oroonoko, below the cataracts, in the Rio Meta, and in the Apure, between the two islands of Carrizales and Conserva. We found no vestiges of nails on the external surface or the edge of the fins, which are quite smooth; but little rudiments of nails appear at the third phalanx, when the skin of the fins is taken off ‡. We dissected one of these animals, which was nine feet long, at Carichana, a mission of the Oroonoko. The upper lip was four inches longer than the lower. It is covered with a very fine skin, and serves as a proboscis or probe to distinguish surrounding objects. The inside of the mouth, which has a sensible warmth in an animal newly killed, presents a very singular conformation. The tongue is almost motionless; but before the tongue there is a fleshy excrescence in each jaw, and a concavity, lined with a very hard skin, into which the excrescence fits. The manatee eats such quantities of grass, that we have found it's stomach, which is divided into several cavities, and it's intestines, which are a hundred and eight feet long, alike filled with it. On opening the animal at the back, we were struck with the magnitude, form, and situation of it's lungs. They have very large cells, and resemble immense swimming bladders. They are three feet long. Filled with air, they have a bulk of more than a thousand cubic inches. I was surprised to see, that, possessing such considerable receptacles for air, the manatee comes so often to the surface of the water to breathe. It's flesh, which,

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* The first of these words belongs to the Tamanack language, and the second to the Otomack. Father Gili proves, in opposition to Oviedo, that the *manati* (fish with *hands)* is not Spanish, but belongs to the languages of Haiti (St. Domingo) and the Maypures. *Storia del Orinoco*, vol. i, p. 84; vol. iii, 225. I believe also, that, according to the genius of the Spanish tongue, the animal would have been called *manudo* or *manon*, but never *manati*.

† It is asserted, that one has been seen of eight thousand pounds weight.

‡ See on the manatee of the Oroonoko, and that of the

West India islands, my *Rec. d'Observations de Zool.*, vol. ii, p. 170. Father Caulin has already said of the manatee, "*Tiene dos brazuelos sin division de dedos y sin unas.*" (*Hist. de Nueva Andalousia*, p. 49).

from what prejudice I know not, is considered unwholesome and *calenturiosa* *, is very savoury. It appeared to me to resemble pork rather than beef. It is most esteemed by the Guanoes and the Otomacks; and these two nations addict themselves particularly to the catching of the manatee. It's flesh, salted and dried in the Sun, can be preserved a whole year; and, as the clergy regard this mammiferous animal as a fish, it is much sought for during Lent. The vital principle is singularly strong in the manatee; it is tied after being harpooned, but is not killed till it has been taken into the canoe. This is effected, when the animal is very large, in the middle of the river, by filling the canoe two-thirds with water, sliding it under the animal, and then baling out the water by means of a calebash. This fishery is the easiest after great inundations, when the manatee has passed from the great rivers into the lakes and surrounding marshes, and the waters diminish rapidly. At the period when the Jesuits governed the missions of the lower Oroonoko, they assembled every year at Cabruta, below the mouth of the Apure, to have a grand fishing for manatees, with the Indians of their missions, at the foot of the mountain now called *El Capuchino*. The fat of the animal, known by the name of *man-*

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* Causing fever.

teca de manati, is used for lamps in the churches; and is also employed in preparing food. It has not the fetid smell of whale oil, or that of other cetaceous animals that spout water. The hide of the manatee, which is more than an inch and half thick, is cut into slips, and serves, like thongs of ox leather, to supply the place of cordage in the Llanos. When immersed in water, it has the defect of undergoing an incipient degree of putrefaction. Whips are made of it in the Spanish colonies. Hence the words *latigo* and *manati* are synonimous. These whips of manatee leather are a cruel instrument of punishment for the unhappy slaves, and even for the Indians of the missions, who, according to the laws, ought to be treated like free men.

We passed the night opposite the island of Conserva. In skirting the forest, we were struck at the view of an enormous trunk of a tree seventy feet high, and thickly set with branching thorns. It is called by the natives *barba de tigre*. It was perhaps a tree of the berberideous family *. The Indians had kindled fires at the edge of the water. We again perceived, that their light attracted the crocodiles, and even the porpoises *(toninas)*, the noise of which interrupted our sleep, till the fire was extinguished. We had two persons on the watch this night; which I mention only because it serves to paint the savage character of these places. A female jaguar approached our station in taking her young one to drink at the river. The Indians succeeded in chasing her away, but we heard for a long time the cries of the little jaguar, which mewed like a young cat. Soon after our great dog was bitten, or, as the Indians say, *pricked* at the point of the nose by some enormous bats, that hovered around our hammocks. They were furnished with a long tail, like the *molosses:* I believe however, that they were *phyllostomes*, the tongue of which, furnished with papillæ, is an organ of suction, and is capable of being considerably elongated. The wound was very small and round. Though the dog uttered a plaintive cry, when he felt himself bitten, it was not from pain, but because he was affrighted at the sight of the bats, that came out from beneath our hammocks. These accidents are much more rare than is believed even in the country itself. In the course of several years, notwithstanding we slept so often in the open air, in climates where vampires * and other analogous species are so common, we were never wounded. Besides, the puncture is no way dangerous, and in general causes so little pain, that it often does not awaken the person, till after the bat has withdrawn.

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* We found, on the banks of the Apure, ammania *apurensis*, cordia *cordifolia*, c. *grandiflora*, mollugo *sperguloides*, myosotis *lithospermoides*, spermacocce *diffusa*, coronilla *occidentalis*, bignonia *apurensis*, pisonia *pubescens*, ruellia *viscosa*, some new species of jussieua, and a new genus of the composite family, approximating to rolandra, the *trichospira menthoides* of Mr. Kunth.

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* Verspertilio spectrum.

April the 4th. This was the last day we passed on the Rio Apure. The vegetation of it's banks becomes more and more uniform. We had begun for some days past, particularly since we had left the mission of Arichuna, to suffer cruelly from the stings of insects, that covered our faces and hands. They were not moschettoes, which have the appearance of little flies, or of the genus *simulium*, but *zancudoes*, which are real gnats, very different from our culex pipiens *. These tipulariæ appear only after sunset. Their proboscis is so long, that, when they fix on the lower surface of a hammock, they pierce the hammock and the thickest garments with their sting.

We had intended to pass the night at the *Vuelta del Palmito*; but the number of jaguars at this part of the Apure is so great, that our Indians found two hidden behind the trunk of a locust-tree, at the moment when they were going to sling our hammocks. We were advised to reembark, and take our station in the island of Apurito, near it's junction with the Oroonoko. That portion of the island belongs to the province of Caraccas, while the right banks of the Apure and the Oroonoko make a part, one of the province of Varinas, the other of Spanish Guayana. We found no trees to which we could suspend our hammocks, and were obliged to sleep on ox hides spread on the ground. The boats are too narrow, and too full of *zancudoes*, to pass the night in them.

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* Mr. Latreille has discovered, that the moschettoes of South Carolina are of the genus simulium (atractocera meigen).

In the place where we had landed our instruments, the banks being steep, we saw new proofs of what I have elsewhere called the indolence of the gallinaceous birds of the tropics. The curassoas and cashew birds* have the habit of going down several times a day to the river to allay their thirst. They drink a great deal, and at short intervals. A great number of these birds had joined themselves near our station to a flock of parraka pheasants. They had great difficulty in climbing up the steep banks; they attempted it several times without using their wings. We drove them before us, as you would drive sheep. The zamuro vultures also raise themselves from the ground with great reluctance.

I had a good observation after midnight of the meridian height of α in the Southern Cross. The latitude of the mouth of the Apure is 7° 36′ 23″. Father Gumilla fixes it at 5° 5′; D'Anville at 7° 3′; and Caulin at 7° 26′. The longitude of the *Boca* of the Apure, calculated from the altitudes of the Sun, which I took on the 5th of April in the morning, is 69° 7′ 29″, or 1° 12′ 41″ east of the meridian of San Fernando.

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* The latter (crax pauxi) is less common than the former.

April the 5th. We were singularly struck at the small quantity of water, which the Rio Apure furnishes at this season to the Oroonoko. The Apure, which, according to my measurements, was still one hundred and thirty-six toises broad at *Cano Ricco,* was only sixty or eighty at it's mouth *. It's depth here was only three or four toises. It loses no doubt a part of it's waters by the Rio Arichuna, and the *Cano* del Manati, two branches of the Apure, that flow into the Payara and the Guarico; but it's greatest loss appears to be caused by filtrations on the beach, of which we have spoken above. The velocity of the Apure near it's mouth was only 3·2 feet a second; so that I could easily have calculated the whole quantity of the water, if I had taken by a series of proximate soundings the whole dimensions of the transverse section. The barometer, which at San Fernando, twenty-eight feet above the mean height of the Apure, had kept, at half after nine in the morning, at 335·6 lines, was, at eleven in the morning, at the entrance of the Apure into the Oroonoko, 337·3 lines *. In estimating the total length, including the sinuosities †, at ninety-four miles, or eighty-nine thousand three hundred toises, and attending to the little correction arising from the horary movement of the barometer, we find a mean fall of thirteen inches (exactly 1·15 foot) in a mile of nine hundred and fifty toises. La Condamine and the learned Major Rennel suppose, that the mean fall of the Amazon and the Ganges does not amount even to four or five inches in a mile ‡.

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* Not quite so broad as the Seine at the Pont Royal, opposite the palace of the Tuileries.

We touched several times on shoals before we entered the Oroonoko. The lands gained from the water are immense toward the confluence of the two rivers. We were obliged to be towed along by the bank. What a contrast between this state of the river, immediately before the entrance of the rainy season, when all the effects of the dryness of the air and of evaporation have attained their *maximum*, and that autumnal state, when the Apure, like an arm of the sea, covers the savannahs as far as the eye can reach! We discerned toward the South the lonely hills of Coruato; while to the East the granitic rocks of Curiquima, the sugarloaf of Caycara, and the mountains of the Tyrant* *(Cerros del Tirano)* began to rise on the horizon. It is not without emotion, that we behold for the first time, after long expectation, the waters of the Oroonoko, at a point so distant from the coast.

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* The temperature of the air in these two places being 31·2° and 32·4°.

† I estimated them at a quarter of the distance.

‡ Tuckey, Exped. to the Congo, 1818; Introduction, p. 17.

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* This name alludes no doubt to the expedition of Antonio Sedeno: thus the port of Caycara, opposite Cabruta, still bears the name of this *Conquistador*.

BOOK VII.

CHAPTER XIX.

Junction of the Apure and the Oroonoko.—Mountains of Encaramada.—Uruana.—Baraguan.—Carichana.—Mouth of the Meta.—Island of Panumana.

On leaving the Rio Apure, we found ourselves in a country of a totally different aspect. An immense plain of water stretched before us like a lake, as far as we could see. White-topped waves rose to the height of several feet, from the conflict of the breeze and the current. The air resounded no longer with the piercing cries of the herons, the flamingoes, and the spoonbills, crossing in long files from one shore to the other. Our eyes sought in vain those water fowls, the inventive snares of which vary in each tribe. All nature appears less animated. Scarcely could we discover in the hollows of the waves a few large crocodiles, cutting obliquely by the help of their long tails, the surface of the agitated waters. The horizon was bounded by a zone of forests, but these forests no where reached so far as the bed of the river. A vast beach constantly parched by the heat of the Sun, desert and bare as the shores of the sea, resembled at a distance, from the effect of the *mirage*, pools of stagnant water. These sandy shores, far from fixing the limits of the river, rendered them uncertain, by approaching or withdrawing them alternately, according to the variable action of the inflected rays.

In these scattered features of the landscape, in this character of solitude and of greatness, we recognize the course of the Oroonoko, one of the most majestic rivers of the New World. The water, like the land, displays every where a characteristic and peculiar aspect. The bed of the Oroonoko resembles not the bed of the Meta, the Guaviare, the Rio Negro, or the Amazon. These differences do not depend altogether on the breadth or the velocity of the current: they are connected with a multitude of impressions, which it is easier to perceive upon the spot, than to define with precision. Thus the mere form of the waves, the tint of the waters, the aspect of the sky and the clouds, would lead an experienced navigator to guess, whether he were in the Atlantic, in the Mediterranean, or in the equinoctial part of the Great Ocean.

The wind blew fresh from East-North-East. It's direction was favourable for our sailing up the Oroonoko, toward the mission of Encaramada; but our canoes were so ill calculated to resist the shocks of the waves, that, from the violence of the motion, those who suffered habitually at sea were incommoded on the river. The short, broken waves are caused by the conflict of the waters at the junction of the two rivers. This conflict is very violent, but far from being so dangerous as Father Gumilla asserts *. We passed the Punta Curiquima, which is an isolated mass of quartzose granite, a small promontory composed of rounded blocks. There, on the right bank of the Oroonoko, Father Rotella founded, in the time of the Jesuits, a mission of Palenka and Viriviri or Guire Indians. At the period of inundations, the rock Curiquima and the village placed at it's foot were surrounded every where by water. This serious inconvenience, and the sufferings of the missionaries and Indians from the innumerable quantity of moschettoes and *niguas* †, led them to forsake this humid spot. It is now entirely desert, while opposite to it, on the right bank of the river, the little mountains of Coruato are the retreat of wandering Indians, expelled either from the missions, or from tribes that are not subjected to the government of the monks.

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* *Orinoco illustrado*, vol. i, p. 47.

† The chego, *pulex penetrans*, which penetrates under the nails of the toes in men and monkeys, and there deposits it's eggs.

Struck with the extreme breadth of the Oroonoko, between the mouth of the Apure and the rock Curiquima, I ascertained it by means of a base measured twice on the western beach. The bed of the Oroonoko in it's present state of low water, was 1906* toises broad; but this breadth attains 5517† toises, when, in the rainy season, the rock Curiquima, and the farm of Capuchino near the hill of Pocopocori, become islands. The swelling of the Oroonoko is augmented by the impulse of the waters of the Apure, which far from forming, like other rivers, an acute angle with the upper part of that into which it flows, meets it at right angles. The temperature of the waters of the Oroonoko, measured in several parts of it's bed, was in the middle of the *thalweg*, or deepest part of the channel, where the current has the most swiftness, 28·3°, and toward the banks, 29·2°.

8 Eng. F.
10 Eng. m
n, 1 furlong.
h. F.

We went up first toward the South-West, as far as the shore of the Guaricoto Indians, on the left bank of the Oroonoko, and then toward the South. The river is so broad, that the mountains of Encaramada appear to rise from the water, as if they were seen above the horizon of the sea. They form a continued chain from East to West. As you approach them, the aspect of the country becomes more picturesque. These mountains are composed of enormous blocks of granite, cleft and piled one upon another. Their division into blocks is the effect of decomposition. What contributes above all to embellish the scene at Encaramada is the force of vegetation, that covers the sides of the rocks, leaving bare only their rounded summits. They look like ancient ruins rising in the midst of a forest. The mountain immediately at the back of the mission, the *Tepupano* * of the Tamanack Indians, is covered by three enormous granitic cylinders, two of which are inclined, while the third, worn away at it's basis, and more than eighty feet high, has preserved a vertical position. This rock, which calls to mind the form of the *Schnarcher* in the Hartz, or that of the *Organs* of *Actopan* in Mexico †, composed formerly a part of the rounded summit of the mountain. In every zone it is the property of unstratified granite, to separate by decomposition into blocks of prismatic, cylindric, or columnar figures.

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* 3714 metres, or 4441 varas, supposing 1 metre = 0·51307 of a toise = 1·19546 vara.

† 10753 metres, or 12855 varas.

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* *Tepu-pano*, "place of stones," in which we recognize *tepu*, "stone, rock," as in *tepu-iri*, mountain. We here again perceive that Lesgian Oigour-Tatar root *tep* (stone), found in America among the Mexicans, in *tepetl;* among the Caribbees, in *tebou;* among the Tamanacks, in *tepuiri;* a striking analogy between the languages of Caucasus and Upper-Asia and those of the banks of the Oroonoko.

† In Captain Tuckey's Voyage on the River Congo, we

Opposite the shore of the Guaricotoes, we drew near another heap of rocks, which is very low, and three or four toises long. It rises in the midst of the plain, and has less resemblance to a *tumulus* than to those masses of granitic stones, which in the North of Holland and of Germany bear the name of *Huenenbette, beds* (or tombs) *of heroes*. The shore at this part of the Oroonoko is no longer of pure and quartzose sand; but is composed of clay and spangles of mica, deposited in very thin strata, and most frequently with a dip of forty or fifty degrees. It looks like decomposed mica-slate. This change in the geological constitution of the shore extends far beyond the mouth of the Apure. We had begun to observe it in this latter river as far off as Algodonal and Caņo del Manati. The spangles of mica come no doubt from the granite mountains of Curiquima and Encaramada; since farther to the North and to the East we find only quartzose sand, sandstone, compact limestone, and gypsum. Alluvial earth carried suc-

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find represented a granitic rock, the *Taddi Enzasi*, which bears a striking resemblance to the mountain of Encaramada.

cessively from the South to the North need not surprise us in the Oroonoko; but to what shall we attribute the same phenomenon in the bed of the Apure, seven leagues West of it's mouth? In the present state of things, notwithstanding the swellings of the Oroonoko, the waters of the Apure never retrograde so far; and, to explain this phenomenon, we are forced to admit, that the micaceous strata were deposited at a time, when the whole of the very low country, that lies between Caycara, Algodonal, and the mountains of Encaramada, formed the basin of an inland lake.

We stopped some time at the port of Encaramada; it is a sort of *embarcadere*, a place where boats assemble. A rock of forty or fifty feet high forms the shore. It is composed of the same blocks of granite, heaped one upon another, as at the Schneeberg in Franconia and in almost all the granitic mountains of Europe. Some of these detached masses have a spheroidal form; they are not balls however, with concentric layers, as we have elsewhere described; but merely rounded blocks, nuclei separated from their envelopes by the effect of decomposition. This granite is of a grayish lead-colour, often black, as if covered with oxide of manganese; but this colour does not penetrate one fifth of a line into the rock, which is of a reddish white within, coarse grained, and destitute of hornblende.

The Indian names of the mission of *San Luis del Encaramada*, are *Guaja* and *Caramana*[*]. This small village was founded in 1749 by Father Gili, the Jesuit, author of the *Storia dell Orinoco*, published at Rome. This missionary, learned in the Indian tongues, lived in this solitude during eighteen years, till the expulsion of the Jesuits. To form a precise idea of the savage state of these countries, we must recollect, that Father Gili speaks of Carichana *, which is forty leagues from Encaramada, as of a spot far distant; and that he never advanced so far as the first cataract of the river, of which he ventured to undertake the description.

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[*] All the missions of South America have names composed of two words, the first of which is necessarily the name of a saint, the patron of the church, and the second an Indian name, that of the nation, or the spot where the establishment is placed. Thus we say, San Jose de Maypures, Santa Cruz de Cachipo, San Juan Nepomuceno de los Atures, &c. These compound names appear only in the official documents; the inhabitants adopt but one of the two names, and generally, provided it be sonorous, the Indian. As the names of saints are several times repeated in neighbouring places, great confusion in geography arises from these repetitions. The names of San Juan, San Diego, and San Pedro, are scattered in our maps as if by chance. It is pretended, that the mission of *Guaji* affords a very rare example of the composition of two Spanish words. The word *Encaramada* means things raised one upon another, from *encaramar, attollere.* It is derived from the figure of Tepupano and the neighbouring rocks: perhaps it is only an Indian word, *caramana*, in which, as in *manati*, from a love for etymology, a Spanish signification was believed to be discovered.

In the port of Encaramada we met with some Caribbees of Panapana. A Cacique was going up the Oroonoko in his canoe, to join in the famous fishing of turtles' eggs. His canoe was rounded toward the bottom like a *bongo*, and followed by a smaller boat called *curiara*. He was seated beneath a sort of tent, *toldo*, constructed, as well as the sail, of palm-leaves. His cold and silent gravity, the respect with which he was treated by his attendants, every thing denoted him to be a person of importance. He was equipped, however, in the same manner as his Indians. They were all equally naked, armed with bows and arrows, and covered with *onoto*, which is the colouring fecula of the bixa orellana. The chief, the domestics, the furniture, the boat, and the sail, were all painted red. These Caribbees are men of an almost athletic stature; they appeared to us much taller than the Indians we had hitherto seen. Their smooth and thick hair, cut upon their forehead like that of choristers, their eyebrows painted black, their look at once gloomy and animated, give their physiognomy a singular hardness of expression. Having till then seen only the skulls of some Caribbees of the West India islands preserved in the collections of Europe, we were surprised to find, that these Indians, who were of pure race, had the forehead much more rounded than it has been described. The women, very tall, but disgusting from their want of cleanliness, carried their infants on their backs, having their thighs and legs bound at certain distances by broad strips of cotton cloth. The flesh, strongly compressed beneath the ligatures, was swelled in the interstices. It is generally to be observed, that the Caribbees are as attentive to their exterior, and their ornaments, as it is possible for men to be, who are naked and painted red. They attach great importance to certain forms of the body; and a mother would be accused of culpable indifference toward her children, if she did not employ artificial means, to shape the calf of the leg after the fashion of the country. As none of our Indians of Apure understood the Caribbee language, we could obtain no information from the Cacique of Panama respecting the encampments, that are made at this season in several islands of the Oroonoko for collecting turtles' eggs.

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* Saggio di Storia Americana, vol. i, p. 122.

Near Encaramada a very long island divides the river into two branches. We passed the night in a rocky creek, opposite the mouth of the Rio Cabullare, which is formed by the Payara and the Atamaica, and is sometimes considered as one of the branches of the Apure, because it communicates with this river by the Rio Arichuna. The evening was beautiful. The moon illumined the tops of the granitic rocks. The heat was so uniformly distributed, that, notwithstanding the humidity of the air, no twinkling of the stars was remarked, even at four or five degrees above the horizon. The light of the planets was singularly dimmed; and if, on account of the smallness of the apparent diameter of Jupiter, I did not suspect some error in the observation, I should say, that here, for the first time, we thought we distinguished the disk of Jupiter with the naked eye. Toward midnight, the North-East wind became extremely violent. It brought no clouds, but the vault of the sky was covered more and more with vapours. Strong gusts were felt, and made us in fear for the safety of our canoe. During this whole day we had seen very few crocodiles, but all of an extraordinary size, from twenty to twenty-four feet. The Indians assured us, that the young crocodiles prefer the marshes, and the rivers that are less broad, and less deep.* They crowd together particularly in the *Canos*, and we might be tempted to say of them, what Abd-Allatif says of the crocodiles of the Nile *,

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* *Descript. de l'Egypte*, translated by Mr. Silvestre de Sacy.

"that they swarm like worms in the shallow waters of the river, and in the shelter of uninhabited islands."

April the 6th. Continuing to ascend the Oroonoko, first toward the South, and then toward the South-West, we perceived the southern side of the *Serrania*, or chain of the mountains of Encaramada. The part nearest the river is only a hundred and forty or a hundred and sixty toises high; but from it's abrupt declivities, it's situation in the midst of a savannah, and it's rocky summits, cut into shapeless prisms, the *Serrania* appears singularly elevated. It's greatest breadth is only three leagues. According to informations given me by the Indians of the Pareka nation, it is considerably wider toward the East. The summits of Encaramada form the northernmost link of a group of mountains, that border the right bank of the Oroonoko, between the latitudes of 5° and 7° 30′ from the mouth of the Rio Zama to that of the Cabullare. The different links, into which this group is divided, are separated by little plains covered with gramina. They do not preserve a direction perfectly parallel to each other; for the northernmost stretch from West to East, and the southernmost from North-West to South-East. This change of direction sufficiently explains the increase of breadth observed in the Cordillera of Parime toward the East, between the sources of the Oroonoko and of the Rio Paruspa. On penetrating beyond the great cataracts of Atures and of Maypures, we shall see seven principal links, those of Encaramada or Sacuina, of Chaviripa, of Baraguan, of Carichana, of Uniama, of Calitamini, and of Sipapo, successively appear. This sketch may serve to give a general idea of the geological constitution of the ground. We recognize every where on the globe a tendency toward regular forms in those mountains, that appear the most irregularly grouped. Every link appears, in a transverse section, like a distinct summit, to those who navigate the Oroonoko; but this division is merely in appearance. The regularity in the direction and separation of the links seems to diminish in proportion as we advance toward the East. The mountains of Encaramada join those of Mato, which give birth to the Rio Asiveru or Cuchivero; those of Chaviripe are prolonged by the granitic mountains of Corosal, of Amoco, and of Murcielago, toward the sources of the Erevato and the Ventuari.

It was across these mountains, which are inhabited by Indians of a gentle character, and addicted to agriculture *, that, at the time of the

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* The Maypoyes, Parecas, Javaranas, and Curacicanas, who possess fine plantations, *conucos*, in the savannahs, by which these forests are bounded.

expedition for settling boundaries, General Iturriaga took some horned cattle, to supply with provision the New Town of San Fernando de Atabapo. The inhabitants of Encaramada then showed the Spanish soldiers the way by the Rio Manapiari * which falls into the Ventuari. By descending these two rivers, the Oroonoko and the Atabapo may be reached without passing the great cataracts, which present almost insurmountable obstacles to the conveyance of cattle. The spirit of enterprise, which had so eminently distinguished the Castillians at the period of the discovery of America, appeared again for some time in the middle of the eighteenth century, when Ferdinand VI was desirous of knowing the real limits of his vast possessions, and in the forests of Guyana, that classic land of falsehood and fabulous traditions, the wily Indians revived the chimerical idea of the wealth of Dorado, which had so much occupied the imagination of the first conquerors.

Amid these mountains of Encaramada, which, like most coarse-grained granitic rocks, are destitute of metallic veins, we cannot help in-

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* Between Encaramada and the Rio Manapiare, Don Miguel Sanchez, chief of this little expedition, crossed the Rio Guainaima, which flows into the Cuchivero. Sanchez died, from the fatigues of this journey, on the borders of the Ventuari.

quiring whence came those grains of gold, which Juan Martinez[*] and Raleigh profess to have seen in such abundance in the hands of the Indians of the Oroonoko. From what I observed in that part of America, I am led to think, that gold, like tin[†], is sometimes disseminated in an almost imperceptible manner in the mass itself of granite rocks, without our being able to admit that there is a ramification and an intertwining of small veins. Not long ago the Indians of Encaramada found in the *Quebrada del Tigre*[‡] a piece of native gold two lines in diameter. It was rounded, and appeared to have been washed along by the waters. This discovery excited the attention of the missionaries much more than of the natives; it was followed by no other of the same kind.

I cannot quit this first link of the mountains of Encaramada, without recalling to mind a fact, that did not remain unknown to Father Gili; and which was often mentioned to me during our abode in the missions of the Oroonoko. The natives of those countries have retained the belief, that, "at the time of the great waters, when "their fathers were forced to have recourse to "boats, to escape the general inundation, the "waves of the sea beat against the rocks of En-"caramada." This belief is not confined to one nation singly, the Tamanacks; it makes part of a system of historical traditions, of which we find scattered notions among the Maypures of the great cataracts; among the Indians of Rio Erevato *, which runs into the Caura; and among almost all the tribes of the Upper Oroonoko. When the Tamanacks are asked how the human race survived this great deluge, the *age of water* of the Mexicans, they say, "a man and a woman saved themselves on a high mountain, called *Tamanacu*, situate on the banks of the Asiveru; and, casting behind them, over their heads, the fruits of the mauritia palm-tree, they saw the seeds contained in those fruits produce men and women, who repeopled the Earth." Thus we find in all it's simplicity, among nations now savage, a tradition, which the Greeks have embellished with all the charms of imagination! A few leagues from Encaramada, a rock, called *Tepu-mereme*, or "the painted rock," rises in the midst of the savannah. It displays resemblances of animals, and symbolic figures, resembling those we saw in going down the Oroonoko, at a small distance below Encaramada, near the town Caycara. Similar rocks in Africa are called by travellers *Fetish Stones.* I shall not make use of this term, because *fetishism* does not prevail among the natives of the Oroonoko; and the figures of stars, of the Sun, of tigers, and of crocodiles, which we found traced upon the rocks in spots now uninhabited, appeared to me in no way to denote the objects of worship of those nations. Between the banks of the Cassiquiare and the Oroonoko; between Encaramada, the Capuchino, and Caycara, these hieroglyphic figures are often placed at great heights on the walls of rock, that could be accessible only by constructing very lofty scaffolds. When the natives are asked how those figures could have been sculptured, they answer with a smile, as relating a fact of which a stranger, a white man only, could be ignorant, that "at the period of the *great waters,* their fathers went to that height in boats."

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[*] The companion of Diego de Ordaz.

[†] Thus tin is found in granite of recent formation, at Geyer; in hyalomicte, or *graisen*, at Zinnwald; and in syenitic porphyry, at Altenberg, in Saxony, as well as near Naila, in the Fichtelgebirge. I have also seen, in the Upper Palatinate, micaceous iron, and black earthy cobalt, far from any kind of vein, disseminated in a granite destitute of mica, as magnetic iron sand is in volcanic rocks.

[‡] Ravine of the tiger.

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* For the Indians of the Erevato, I can cite the testimony of our unfortunate friend, Fray Juan Gonzales, who lived for a long time in the missions of the Caura. See above, vol. iii, p. 331.

These ancient traditions of the human race, which we find dispersed over the whole surface of the Globe, like the relics of a vast shipwreck, are highly interesting in the philosophical study of our own species. Like certain families of the vegetable kingdom, which, notwithstanding the diversity of climates and the influence of heights, retain the impression of a common type, the cosmogonic traditions of nations display every where the same physiognomy, and preserve features of resemblance, that fill us with astonishment. How many different tongues, belonging to branches that appear completely distinct, transmit to us the same facts! The basis of the traditions concerning races that are destroyed, and the renewal of nature, scarcely vary*; though every nation gives them a local colouring. In the great continents, as in the smallest islands of the Pacific Ocean, it is always on the loftiest and nearest mountain, that the remains of the human race have been saved; and this event appears the more recent, in proportion as the nations are uncultivated, and as the knowledge they have of their own existence has not a very remote date. After having studied with attention the Mexican monuments anterior to the discovery of the New World; after having penetrated into the forests of the Oroonoko, and observed the diminutiveness of the European establishments, their solitude, and the state of the tribes that have remained independent; we cannot permit ourselves to attribute the analogies we have just cited to the influence of the missionaries, and that of Christianity, on the national traditions. Nor is it more probable, that the aspect of marine bodies found on the summit of mountains gave birth among the nations of the Oroonoko to the idea of those great inundations, which have extinguished for a time the germes of organic life on our Globe. The country, that extends from the right bank of the Oroonoko to the Cassiquiare and the Rio Negro, is a country of primitive rocks. I saw there one small formation of sandstone, or conglomerate; but no secondary limestone, no trace of petrifactions.

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* See my *Monumens des Peuples indigènes de l'Amérique*, p. 204, 206, 223, and 227.

A fresh North-East wind carried us full sail toward the *boca de la Tortuga*. We landed at eleven in the morning in an island, which the Indians of the missions of Uruana considered as their property, and which is placed in the middle of the river. This island is celebrated for the turtle fishery; or, as they say here, the *cosecha*, the *harvest of eggs*, that takes place annually. We here found an assemblage of Indians, encamped under huts constructed with palm-leaves. This encampment contained more than three hundred persons. Accustomed since we had left San Fernando de Apure, to see only desert shores, we were singularly struck by the movement that prevailed here. We found, beside the Guamoes and the Ottomacks of Uruana, who are both considered as savage races not to be tamed, Caribbees and other Indians of the Lower Oroonoko. Every tribe was separately encamped, and distinguished by the pigments, with which their skin was painted. Some white men were seen amid this tumultuous assemblage, chiefly *pulperos*, or little traders of Angostura, who had come up the river to purchase oil of turtles' eggs from the natives. The missionary of Uruana, a native of Alcala de Henarez, came to meet us. He was extremely astonished at seeing us. After having admired our instruments, he gave us an exaggerated picture of the sufferings, to which we should be necessarily exposed in ascending the Oroonoko beyond the cataracts. The object of our voyage appeared to him very mysterious. " How is it possible to believe," said he, " that you have left your country, to come and be devoured by moschettoes on this river, and measure lands that are not yours?" We were happily furnished with recommendations from the Father guardian of the missions of Saint Francis; and the brother-in-law of the governor of Varinas, who accompanied us, soon dissipated the doubts, to which our dress, our accent, and our arrival in this sandy island, had given rise among the Whites. The missionary invited us to partake a frugal repast of fish and plantains. He told us, that he was come to encamp with the Indians during the time of the *harvest of eggs*, " to celebrate mass every morning in the open air, to procure the oil necessary for the lamp of the Church, and especially to govern this *republica de Indios y Castellanos,* in which every one wished to profit singly by what God had granted to all."

We made the tour of the island, accompanied by the missionary, and by a *pulpero,* who boasted of having visited ten years successively the camp of the Indians, and the *pesca de tortugas.* This part of the banks of the Oroonoko is frequented here, as the fairs of Frankfort and Beaucaire are with us. We were on a plain of sand perfectly smooth; and were told, that, as far as we could see along the beach, turtles' eggs were concealed under a layer of earth. The missionary carried a long pole in his hand. He showed us, that, by means of this pole *(vara)* the extent of the stratum of eggs could be determined, as the miner determines the limits of a bed of marl, of bog iron-ore, or of coal. On thrusting the *vara* perpendicularly into the ground, you feel by the sudden want of resistance, that you have penetrated into the cavity, or layer of loose earth, containing the eggs. We saw, that the stratum is generally spread with so much uniformity, that the pole finds it every where in a radius of ten toises around any given mark. Here they talk continually of *square perches of eggs;* it is like a mine country, that is divided into lots, and worked with the greatest regularity. The stratum of eggs, however, is far from covering the whole island: they are not found wherever the ground rises abruptly, because the turtle cannot mount these little heights. I related to my guides the emphatic description of Father Gumilla *, who asserts, that the shores of the Oroonoko contain fewer grains of sand, than the river contains turtles; and that these animals would prevent vessels from advancing, if men and tigers did not annually destroy so great a number. "*Son cuentos de frailes,*" said the pulpero of Angostura in a low voice; for the only travellers in this country being poor missionaries, they here call *tales of monks,* what we call *tales of travellers* in Europe.

The Indians assured us, that in going up the Oroonoko from it's mouth to the junction of the Apure, not one island, or one beach is to be found, where eggs can be collected in abundance. The great turtle, *arrau* †, dreads places inhabited by men, or much frequented by boats. It is a timid and mistrustful animal, that raises it's head above the water, and hides itself at the least noise. The shores, where almost all the turtles of the Oroonoko appear to assemble annually, are situate between the junction of the Oroonoko with the Apure, and the great cataracts, or *Raudales*; that is to say, between Cabruta and the mission of Atures. There are found the three famous fisheries; those of Encaramada, or Boca del Cabullare; of Cucuruparu, or Boca de la Tortuga; and of Pararuma, a little below Carichana. It seems, that the *arrau* does not pass beyond the cataracts; and we were assured, that only the turtles called terekay* are found above Atures and Maypures. This is the place to say a few words on the difference between these two species, and on their connection with the various families of the *chelonian* order.

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* Tam difficultoso es contar las arenas de las dilatadas playas del Orinoco como contar el immenso numero de tortugas, que alimenta en sus margenes y corrientes. Se no ubiesse tan exorbitante consumo de tortugas, de tortuguillos, y de huevos, el Rio Orinoco, aun de primera magnitud, se bolberia innavegable, sirviendo de embarazo a las embarcaciones la multitud imponderable de tortugas. Orinoco illustr., vol. i, p. 331—336.

† Pronounce *ara-ou.* This word belongs to the Maypure language, and must not be confounded with *arua,* which

We shall begin with the *arrau*, which the Spaniards of the missions call simply *tortuga*, and the existence of which is of so great importance to the nations on the Lower Oroonoko. It is a large fresh-water tortoise, with palmate

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means a crocodile among the Tamanacks, neighbours of the Maypures. The Otomacks call the turtle of Uruana, *achea*; the Tamanacks, *peje*.

* In Spanish *terecayas*.

and membranous feet; the head very flat, with two fleshy and acutely-pointed appendages under the chin; five claws to the fore-feet, and four to the hind feet, which are furrowed underneath. The upper shell has five scutels in the centre, eight lateral, and twenty-four marginal. The colour is darkish gray above, and orange beneath. The feet are also yellow, and very long. There is a deep furrow between the eyes. The claws are very strong and very crooked. The anus is placed at the distance of one fifth from the extremity of the tail. The full-grown animal weighs from forty to fifty pounds. It's eggs, much larger than those of pigeons, are less elongated than the eggs of the *terekay*. They are covered with a calcareous crust, and, it is said, have sufficient firmness for the children of the Otomack Indians, who are great players at ball, to throw them up into the air from one to another to catch. If the *arrau* inhabited the bed of the river above the cataracts, the Indians of the Upper Oroonoko would not travel so far, to procure the flesh and the eggs of this tortoise. Yet formerly whole tribes from the Atabapo and the Cassiquiare have been known to pass the *Raudales*, in order to take part in the fishery at Uruana.

The *terekay* is less than the *arrau*. It is in general only fourteen inches in diameter. The number of scutels in the upper shell is the same, but they are somewhat differently arranged. I counted three in the centre of the disk, and five hexagonal on each side. The margins contain twenty-four, all quadrangular, and much curved. The upper shell is of a black colour inclining to green; the feet and claws are like those of the *arrau*. The whole animal is of an olive-green, but it has two spots of red mixed with yellow on the top of the head. The throat is also yellow, and furnished with a prickly appendage. The *terekays* do not assemble in numerous societies like the *arraus*, or *tortugas*, to lay their eggs in common, and deposit them upon the same shore. The eggs of the *terekay* have an agreeable taste, and are much sought after by the inhabitants of Spanish Guyana. They are found in the Upper Oroonoko, as well as below the cataracts, and even in the Apure, the Uritucu, the Guarico, and the small rivers that traverse the *Llanos* of Caraccas. The form of the feet and head, the appendages of the chin and throat, and the position of the anus, seem to indicate, that the *arrau*, and probably the *terekay* also, belong to a new subdivision of the tortoises, that may be separated from the *emydes*. From their cirri, and the position of the anus, they approximate the *emys nasuta* of Mr. Schweigger and the *matamata* of French Guyana; but differ from the latter in the form of the scutels, which are not rough with pyramidal eminences *. The period at which the large *arrau* tortoise lays it's eggs

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* I would propose to place them provisionally near the matamata of Bruguières, or testudo fimbriata of Gmelin (Schoepf, tab 21), which Mr. Dumeril has taken to form his genus chelys.

Testudo arrau, testa ovali subconvexa, ex griseo nigrescenti, subtus lutea, scutellis disci 5, lateralibus 8, marginalibus 24, omnibus planis (nec mucronato-conicis), pedibus luteis, mento et gutture subtus biappendiculatis.

Testudo terekay, testa ovali, atro-viridi, scutellis disci 3, lateralibus 10, marginalibus 24, capitis vertice maculis duabus ex rubro flavescentibus notato, gutture lutescenti, appendiculo spinoso.

These descriptions are far from being complete, but are the first which have been attempted of two chelonians, so long celebrated from the narratives of the missionaries, and so remarkable for the advantages derived from them by the natives. Among the animals contained in the collection of the Jardin du Roi, it is observable, that in the testudo fimbriata (with twenty-five marginal scales) the aperture of the anus is placed nearly in the same manner as in the two tortoises of the Oroonoko, of which I have here given the description, and in the tryonix ægyptiaca, that is to say, at one fourth from the extremity of the tail. This position of the anus deserves to fix the attention of zoologists: it, as well as the existence of an elongated proboscis in the matamata, approximates the chelides to the tryonix; but these genera differ in the number of their claws, and the consistence of their shell. Mr. Geoffroy, guided by other considerations, had already supposed the existence of these relations. (*Ann. du Muséum*, vol. xiv, p. 19.) The anus in the chelonians, the land-tortoises, and the real emydes, is placed at the base of the tail. I find described in my journal only very young *arraus*. I coincides with the period of the lowest waters. The Oroonoko beginning to increase from the vernal equinox, the lowest shores are found uncovered from the end of January till the 20th or 25th of March. The *arrau* tortoises, collected in troops from the month of January, issue then from the water, and warm themselves in the Sun, reposing on the sands. The Indians believe, that a great heat is indispensable to the

have made no mention of a proboscis; and, if I dared to trust my memory, I should say, that the adult *arrau* is not furnished with one like the *matamata*. We must not forget, however, that the genus *chelys* has been formed from the knowledge of one species only, and what belongs to the genus, and what belongs to the species, may have been confounded. The true characteristics of the new genus *chelys* are the form of the mouth, and the membranous appendages of the chin and neck. I never found in America the real testudo fimbriata of Cayenne, the scales of which have a conic and pyramidal form; and I was the more surprised to see, that Father Gili, missionary at Encaramada, three hundred and twenty leagues from Cayenne, in a work published in 1788, already distinguished the *arrau* and the *terekay* from a much smaller tortoise, which he calls *matamata*. He gives it in his Italian description, *il guscio no convesso come nelle altre tartarughe, ma piano, scabroso e deforme.* These last characters very well agree with the testudo fimbriata; and, as Father Gili was acquainted neither with zoology, nor with the books that treat of this science, we may suppose, that he described the matamata of the Oroonoko as he saw it. From these researches it results, that three neighbouring species, the arrau, the terekay, and the testudo fimbriata, inhabit one and the same region of the New Continent.

health of the animal, and that it's exposure to the Sun favours the laying of the eggs. The *arraus* are found on the beach a great part of the day during the whole month of February. At the beginning of March the straggling troops assemble, and swim toward the small number of islands, where they habitually deposit their eggs. It is probable, that the same tortoise visits every year the same shores. At this period, a few days before they lay their eggs, thousands of these animals appear ranged in long files on the borders of the islands of Cucuruparu, Uruana, and Pararuma, stretching out their necks and holding their heads above water, to see whether they have nothing to dread from tigers or men. The Indians, much interested that the bands already assembled should remain complete, that the tortoises should not disperse, and that the laying of the eggs should be performed tranquilly, place centinels at certain distances along the shore. The people who pass in boats are told to keep in the middle of the river, and not frighten the tortoises by cries. The laying of the eggs takes place always during the night. It begins soon after sunset. With it's hind feet, which are very long, and furnished with crooked claws, the animal digs a hole of three feet in diameter and two feet in depth. The Indians assert, that the tortoise, to harden the sand of the beach, moistens it with it's urine. This they think they perceive by the smell, when they open a hole, or, as they say here, a *nest of eggs* *, recently made. These animals feel so pressing a desire to lay their eggs, that some of them descend into holes, that have been dug by others, and are not yet covered with earth. They there deposit a new layer of eggs on that which has been recently laid. In this tumultuous movement an immense number of eggs are broken. The missionary showed us, by removing the sand in several places, that this loss may amount to one fifth of the whole gathering. The yolk of the broken eggs contributes in drying to cement the sand; and we found very large concretions of grains of quartz and broken shells. The number of animals that dig the beach during the night is so considerable, that day surprises many of them before the laying of their eggs is terminated. They are then urged on by the double necessity of depositing their eggs, and closing the holes they have dug, that they may not be perceived by the tigers. The tortoises that thus remain too late are insensible to their own danger. They work in the presence of the Indians, who visit the beach at a very early hour, and who call them *mad tortoises.* Notwithstanding the impetuosity of their movements, they are easily caught with the hand.

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* *Nidada de huevos.*

The three encampments formed by the Indians in the places indicated above begin about the end of March or commencement of April. The gathering of the eggs is conducted in a uniform manner, and with that regularity, which characterizes all monastic institutions. Before the arrival of the missionaries on the banks of the river, the Indians profited much less from a production, which nature has there deposited in such abundance. Every tribe searched the beach in it's own way; and an immense number of eggs were uselessly broken, because they were not dug with precaution, and more eggs were uncovered than could be carried away. It was like a mine worked by unskilful hands. The Jesuits have the merit of having reduced this operation to regularity; and though the monks of St. Francis, who have succeeded the Jesuits in the missions of the Oroonoko, boast of having followed the example of their predecessors, they unhappily do not effect all that prudence requires. The Jesuits did not suffer the whole beach to be searched; they left a part intact, from the fear of seeing the breed of *arrau* tortoises, if not destroyed, at least considerably diminished. The whole beach is now dug up without reserve; and accordingly it seems to be perceived that the gathering is less productive from year to year.

When the camp is formed, the missionary of

Uruana names his lieutenant, or *commissary*, who divides the ground where the eggs are found into different portions, according to the number of the Indian tribes who take part in the gathering. They are all *Indians of missions*, as naked and rude as the *Indians of the woods*; though they are called *reducidos* and *neofitos*, because they go to church at the sound of the bell, and have learned to kneel down during the consecration of the host.

The lieutenant or *commissionado del Padre* begins his operations by sounding. He examines by means of a long wooden pole or a cane of bamboo, as we have said above, how far *the stratum of eggs* extends. This *stratum*, according to our measurements, reached from the shore as far as one hundred and twenty feet distant. It's mean depth is three feet. The *comissionado* places marks, to indicate the point, where each tribe should stop in it's labours. We were surprised to hear *this harvest of eggs* estimated like the produce of a well cultivated acre. An *area* accurately measured of one hundred and twenty feet long, and thirty feet wide, has been known to yield one hundred jars of oil, or to the value of a thousand francs. The Indians remove the earth with their own hands; they place the eggs they have collected in small baskets, called *mappiri*, carry them to the camp, and throw them into long troughs of wood filled with water. In these troughs the eggs, broken and stirred with shovels, remain exposed to the Sun, till the yolk, the oily part, which swims on the surface, has time to *inspissate*. As fast as this oily part is collected on the surface of the water, it is taken off, and boiled over a quick fire. This animal oil, called *manteca de tortugas* *, keeps the better, it is said, in proportion as it has undergone a stronger ebullition. When well prepared, it is limpid, inodorous, and scarcely yellow. The missionaries compare it to the best oil of olives; and it is used not merely to burn in lamps, but in dressing victuals, to which it imparts no disagreeable taste. It is not easy, however, to procure oil of turtles' eggs quite pure. It has generally a putrid smell, owing to the mixture of eggs, in which, from the prolonged action of the Sun, little tortoises, *los tortuguillos*, are already formed. We felt this very disagreeably at our return from the Rio Negro, on employing a fluid fat, which had become brown and fetid. Fibrous matter was found collected at the bottom of the vessel; a sign of the impurity of the tortoise-oil.

I acquired some general statistical notions on the spot, by consulting the missionary of Uruana, his lieutenant, and the traders of Angostura. The shore of Uruana furnishes one thousand botijas * or jars of oil *(manteca)* annually. The price of each jar at the capital of Guiana, vulgarly called Angostura, is from two piastres to two and a half. We may admit, that the total produce of the three shores, where the *cosecha* or gathering of eggs is annually made, is five thousand *botijas.* Now as two hundred eggs yield oil enough to fill a bottle, or *limeta,* it requires five thousand eggs for a jar or *botija* of oil. Estimating at one hundred, or one hundred and sixteen, the number of eggs, that one tortoise produces; and reckoning that one third of these is broken at the time of laying, particularly by the *mad tortoises;* we may presume, that, to obtain annually five thousand jars of oil, three hundred and thirty thousand *arrau* tortoises, the weight of which amounts to one hundred and sixty-five thousand quintals, must come and lay thirty-three millions of eggs on the three shores appropriated to this harvest. The results of these calculations are much below the truth. Many tortoises lay only sixty or seventy eggs; and a great number of these animals are devoured by jaguars at the moment they get out of the water. The Indians bring away a great number of eggs to eat them dried in the Sun; and they break a considerable number through carelessness during the gathering. The number of eggs that are hatched before the people can dig them up is so prodigious, that near the encampment of Uruana I saw the whole shore of the Oroonoko swarming with little tortoises an inch in diameter, escaping with difficulty from the pursuits of the Indian children. If to these considerations be added, that all the *arraus* do not assemble on the three shores of the encampments; and that there are many that lay their eggs in solitude, and some weeks later *, between the mouth of the Oroonoko and the confluence of the Apure; we must admit, that the number of turtles, which annually deposite their eggs on the banks of the Lower Oroonoko, is near a million. This number is very considerable for so large an animal, weighing half a quintal, and of which the greater part is destroyed by men. In general nature multiplies less the great species of animals than the small.

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* *Tortoise grease.* The Tamanack Indians call it by the name of *carapa*; the Maypures, by the name of *timi*.

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* Each *botija* contains twenty-five bottles: it's capacity is from 1000 to 1200 cubic inches.

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* The *arraus,* which lay their eggs before the beginning of March; for in the same species the more or less frequent basking in the Sun, the food, and the peculiar organization of each individual, occasion differences; come out of the water with the *terekays,* which lay in January and February. Father Gumilla believes them to be *arraus,* that were not able to lay their eggs the preceding year! All that Father Gili relates of the *terekay* (vol. i, p, 96, 101, and 297) agrees entirely with what I learned from the governor of the Otomacks of Uruana, who understood Spanish, and with whom I could converse. It is difficult to find the eggs of the *terekays,* because these animals, far from collecting in thousands on the same beach, deposit their eggs as they are scattered about.

The labours of collecting the eggs, and preparing the oil, last three weeks. It is at this period only, that the missionaries have any communication with the coast, and the civilized neighbouring countries. The monks of St. Francis, who live South of the cataracts, come to the *harvest of eggs* less to procure oil, than to see, as they say, "*white faces*;" and to learn, "whether the king inhabits the Escurial or Saint Ildefonso, whether the convents remain suppressed in France, and above all whether the Turks continue to keep quiet." These are the only subjects, that are interesting to a monk of the Oroonoko, and on which the little traders of Angostura, who visit the encampments, can give no very exact notions. In those distant countries no doubt is ever entertained of the news brought by a white man from the capital. To doubt is almost to reason; and how can it be otherwise than irksome to exercise the understanding, where people pass their lives in complaining of the heat of the climate, and the stinging of moschettoes? The profit of the traders in oil amounts to seventy or eighty per cent; for the Indians sell it them at the price of a piastre a jar or *botija*, and the expense of carriage is not more than two fifths of a piastre per jar*. The Indians, when they go to the *cosecha de huevos,* bring away also a considerable quantity of eggs dried in the Sun, or exposed to a slight ebullition. Our rowers had baskets or little bags of cotton cloth filled with these eggs. Their taste is not disagreeable, when well preserved. We were shown large shells of turtles, emptied by the jaguar-tigers. These animals follow the *arraus* toward the beaches, where the laying of the eggs is to take place. They surprise them on the sand; and, in order to devour them at their ease, turn them in such a manner that the under shell is uppermost. In this situation the turtles cannot rise; and as the jaguar turns many more than he can eat in one night, the Indians often avail themselves of his cunning and malignant avidity.

When we reflect on the difficulty that the naturalist finds in getting out the body of the turtle without separating the upper and under shells, we cannot enough admire the suppleness of the tiger's paw, which empties the double armour of the *arrau,* as if the adhering parts of the muscles had been cut by means of a surgical instrument. The jaguar pursues the turtle quite into the water, when it is not very deep. It even digs up the eggs; and together with the crocodile, the herons, and the *gallinazo* vulture, is the most cruel enemy of the little turtles recently hatched. The island of Pararuma had been so much infested with crocodiles the preceding year, during the harvest of eggs, that the Indians in one night caught eighteen, of twelve or fifteen feet long, by means of curved pieces of iron, baited with the flesh of the manatee. Beside the beasts of the forest we have just named, the wild Indians also do much damage to the fabrication of the oil. Warned by the first slight rains, which they call *turtle rains* (*peje canepori* *), they hasten to the banks of the Oroonoko, and kill with poisoned arrows the turtles, as with the head raised, and the paws extended, they warm themselves in the Sun.

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* First cost of 300 *botijas,* 300 piastres. Expenses of conveyance: a boat, *lancha,* with four rowers, and a master, 60 p.: two cows, for the food of the rowers during two months, 10 p.: cassava, 20 p.: petty expenses in the camp, 30 p.: total, 420 p. The 300 botijas fetch at Angostura from 600 to 750 piastres, according to the mean price of ten years.

Though the little turtles (*tortuguillos*) may have burst the shell of their egg during the day, they are never seen to come out of the ground but at night. The Indians assert, that the young animal fears the heat of the Sun. They tried also to show us, that when the *tortuguillo* is carried in a bag to a distance from the shore, and placed in such a manner, that it's tail is turned to the river, it takes without hesitation the shortest way to the water. I confess, that this experiment, of which Father Gumilla speaks, does not always succeed equally well: yet in general it appears, that at great distances from the shore, and even in an island, these little animals feel with extreme delicacy on what side the most humid air blows.

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* In the Tamanack language, from *peje*, a tortoise, and *canepo*, rain.

Reflecting on this almost continued layer of eggs, that extends along the beach, and on the thousands of little turtles, that seek the water as soon as they are hatched, it is difficult to admit, that so many turtles, which have made their nests in the same spot, can distinguish their own young, and lead them like the crocodiles to the pools in the vicinity of the Oroonoko. It is certain, however, that the animal passes the first years of it's life in the pools where the water is less deep, and does not return to the bed of the great river, till it is full grown. How then do the *tortuguillos* find these pools? Are they led thither by female turtles, which adopt the young as by chance? The crocodiles, less numerous, deposite their eggs in separate holes; and we shall soon find, that, in this family of sauriens, the female returns about the time when the incubation is terminated; calls her young, which answer to her voice; and often assists them to get out of the ground. The *arrau* tortoise no doubt like the crocodile knows the spot, where she has made her nest; but, not daring to return to the beach, where the Indians have formed their encampment, how can she distinguish her own young from the *tortuguillos* that do not belong to her? On the other hand, the Otomack Indians declare, that, at the period of the inundations, they have met with female turtles followed by a great number of young ones. These were perhaps *arraus*, that laid eggs on a desert beach, to which they could return. Males are extremely rare among these animals. Scarcely is one male found among several hundred females. The cause of this scarcity cannot be the same as with the crocodiles, which fight in the season of their loves.

Our pilot had anchored at the *Playa de huevos*, to purchase some provision, which began to run short with us. We found there fresh meat, Angostura rice, and even biscuit made of wheaten flour. Our Indians filled the boat with little live turtles, and eggs dried in the Sun, for their own use. Having taken leave of the missionary of Uruana, who had treated us with great cordiality, we set sail about four in the afternoon. The wind was fresh, and blew in squalls. Since we had entered the mountainous part of the country, we had discovered, that our canoe carried sail very badly; but the master was desirous of showing the Indians, who were assembled on the beach, that, in going as near the wind as possible, he should reach at one single tack the middle of the river. At the very moment when he was boasting of his dexterity, and the boldness of his manœuvre, the force of the wind upon the sail became so great, that we were on the point of going down. Our side of the boat was under water, which entered with such violence, that it was up to our knees. It passed over a little table, at which I was writing in the after part of the boat. I had some difficulty to save my journal, and in an instant we saw our books, papers, and dried plants, all swimming. Mr. Bonpland was lying asleep in the middle of the canoe. Awakened by the entrance of the water, and the cries of the Indians, he judged of our situation with that coolness, which he always displayed in the most difficult circumstances. The lee side righting itself from time to time during the squall, he did not consider the boat as lost. He thought, that, were we even forced to abandon it, we should save ourselves by swimming, since there was no crocodile in sight. Amid this uncertainty, we saw the cordage of the sail suddenly give way. The same gust of wind, that had thrown us on our beam, served also to right us. We instantly laboured to bale the boat with calebashes; the sail was set afresh; and in less than half an hour we were again in a state to proceed. The wind had abated a little. Squalls alternating with dead calms are very common in that part of the Oroonoko, which is bordered by mountains. They become very dangerous for boats deeply laden, and without decks. We had escaped as by miracle. To the reproaches that were heaped on our pilot for having kept too near the wind he opposed his Indian phlegm; and answered coldly, "that the Whites would not want Sun enough on those banks to dry *their papers*." We lost only one book; the first volume of the *Genera Plantarum* of Schreber, which had fallen into the water. Such losses are felt by those who are reduced to a small number of works of science.

At the beginning of the night we landed on a barren island in the middle of the river, near the mission of Uruana. We supped by a beautiful moonlight, and were seated on large shells of turtle, that were found scattered on the beach. What delightful satisfaction did we feel at finding ourselves thus assembled! We figured to ourselves the situation of a man, who had been saved alone from shipwreck, wandering on these desert shores, meeting at every step with other rivers, that fall into the Oroonoko, and which it is dangerous to pass by swimming, on account of the multitude of crocodiles, and *caribe* fishes, We represented to ourselves such a man, awake to the most tender affections of the soul, ignorant of the fate of the companions of his misfortune, and thinking more of them than of himself. If we love to indulge such melancholy meditations, it is because, when just escaped from danger, we seem to feel something like a want of strong emotions. The minds of each of us were full of what we had just witnessed. There are periods in life, when, without being discouraged, the future appears more uncertain. It was only three days since we had entered the Oroonoko; and there yet remained three months for us to navigate rivers incumbered with rocks, and in smaller boats than that in which we had nearly perished.

The night was intensely hot. We lay upon skins spread on the ground, not finding any trees to which we could fasten our hammocks. The torments of the moschettoes increased every day; and we were surprised to find, that on this spot our fires did not prevent the approach of the jaguars. They swam across the arm of the river that separated us from the main land. Toward morning we heard their cries very near. They had come to the island where we passed the night. The Indians told us, that, during the collecting of the turtles' eggs, tigers are always more frequent in those regions, and display at that period the greatest intrepidity.

April the 7th. We passed, on our right, the mouth of the great Rio Arauca, celebrated on account of the immense number of birds that frequent it; and, on our left, the mission of Uruana, vulgarly called the *Concepcion de Urbana.* This small village, which counts five hundred souls, was founded by the Jesuits about the year 1748, by the union of the Otomack and Caveres or Cabre Indians. It is placed at the foot of a mountain, composed of detached blocks of granite. This mountain I believe bears the name of *Saraguaca.* Heaps of stones, separated one from the other by the effect of decomposition, form caverns, in which we find indubitable proofs of the ancient cultivation of the natives. Hieroglyphic figures, and even characters in regular lines, are seen sculptured there. I doubt whether these characters bear any analogy to alphabetic writing *. We visited the mission of Uruana at our return from the Rio Negro, and saw with our own eyes those heaps of earth which the Otomacks eat, and which are become an object of such lively discussion in Europe.

On measuring the breadth of the Oroonoko between the islands called *Isla de Uruana* and *Isla de la Manteca,* we found it, during the high waters, 2674 † toises, which make nearly four nautical miles. This is eight times the breadth of the Nile at Manfalout and Syout *, yet we were at the distance of a hundred and ninety-four leagues from the mouth of the Oroonoko.

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* See my Monuments of the ancient Inhabitants of America, vol. i, (or vol. xiii, of the present work,) Eng. edit. p. 153.

† Or 5211 metres, or 6230 varas.

The temperature of the water at it's surface was 27·8° of the centigrade thermometer, near Uruana. That of the river Zara, or Congo, in Africa, at an equal distance from the equator †, was found by Captain Tuckey, in the months of July and August, to be only from 23·9° to 25·6°. We shall hereafter see, that the waters of the Oroonoko, as well near the banks, where they flow beneath a thick shade, as in the channel in the middle of the river, rise to 29·5° ‡, and never sink below 27·5° §; but the air also at this period, from April to June, was generally between 28° and 30° in the day, and at night between 24° and 26°, while in the valley of Congo the temperature kept, from eight in the morning till noon, between 20·6° and 26·7°.

The western bank of the Oroonoko remains low farther than the mouth of the Meta; while from the mission of Uruana the mountains approach the eastern bank more and more. As the strength of the current increases in proportion as the river grows narrower, the progress of

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* *Girard, sur la Vallée d'Egypt,* p. 12.

† In the southern hemisphere.

‡ As high as 23·6° R.

§ 22·0° R.

our boat became much slower. We continued to ascend the Oroonoko under sail, but the high and woody grounds deprived us of the wind. At other times the narrow passes between the mountains, by which we sailed, sent us violent gusts, but of short duration. The number of crocodiles augmented below the confluence of the Rio Arauca, particularly opposite the great lake of Capanaparo, which communicates with the Oroonoko, as the Laguna de Cabullarito communicates at the same time with the Oroonoko and the Rio Arauca. The Indians told us, that the crocodiles came from the inlands, where they had been buried in the dried mud of the savannahs. As soon as the first showers awaken them from their lethargy, they crowd together in troops, and hasten toward the river, there to disperse again. Here, in the equinoctial zone, it is the increase of humidity that recalls them to life; while in Georgia and Florida, in the temperate zone, it is the augmentation of heat, that rouses these animals from a state of nervous and muscular debility, during which the active powers of respiration are suspended, or singularly diminished. The season of great drought, improperly called the *summer* of the torrid-zone, corresponds to the winter of the temperate zone; and it is a curious physiological phenomenon, to observe the alligators of North America plunged into a *winter sleep* by excess of cold, at the same period when the crocodiles of the Llanos begin their *siesta*, or summer sleep. If it were probable, that these animals of the same family had heretofore inhabited the same northern country, we might suppose, that, in advancing toward the equator, they feel the want of repose after exercising their muscles for seven or eight months; and that they retain under a new sky the habits *, that appear to be essentially linked with their organization.

Having passed the mouths of the channels, that communicate with the lake of Capanaparo, we entered a part of the Oroonoko, where the bed of the river is narrowed by the mountains of *Baraguan*. It is a kind of strait, reaching nearly to the confluence of the Rio Suapure. From these granite mountains the natives heretofore gave the name of Baraguan to that part of the Oroonoko, which is comprised between the mouths of the Arauca and the Atabapo. Among savage nations great rivers bear different denominations in the different portions of their course. *The passage of Baraguan* presents a picturesque scene. The granite rocks are perpendicular. They form a range of mountains lying North-West and South-East; and the river cutting this dyke nearly at a right angle, the summits of the mountains appear like separate peaks. Their elevation in general does not surpass one hundred and twenty toises; but their situation in the midst of a small plain, their steep declivities, and their sides destitute of vegetation, give them a majestic character. They are composed of enormous masses of granite, of a parallelopipedal figure, but rounded at the edges, heaped one upon another. The blocks are often eighty feet long, and twenty or thirty broad. They would seem to have been piled up by some external force, if the proximity of a rock identical in it's composition, not separated into blocks but filled with veins *, did not prove, that the parallelopipedal form is owing solely to the action of the atmosphere. These veins, two or three inches thick, are distinguished by a fine-grained quartz granite, crossing a coarse-grained granite almost porphyritic, and abounding in fine crystals of red feldspar. I sought in vain in the Cordillera of *Baraguan* for hornblende, and those steatitic masses, that characterize several granites of the high Alps in Switzerland.

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* See above, p. 89.

We landed in the middle of the strait of *Baraguan*, to measure it's breadth. The rocks project so much toward the river, that I measured with difficulty a base of eighty toises. I found the river eight hundred and eighty-nine toises broad. In order to conceive how this passage bears the name of a strait, we must recollect, that the breadth of the river from Uruana to the junction of the Meta is in general from 1500 to 2500 toises. In this place, extremely hot and barren, I measured two granitic summits, much rounded, one of which was only a hundred and ten, and the other eighty-five toises. There are higher summits in the interior of the group, but in general these mountains, of so wild an aspect, have not the elevation that is assigned to them by the missionaries.

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* Their direction is generally, hor. 3. I also saw a great number of these veins following the directions hor. 6—11, in the winter harbour *(Puerto de invierno)* of Atures. These contain no vacuities, no vestige of *druses*. They are, as at *Baraguan*, veins of fine-grained granite traversing coarse-grained granite.

We looked in vain for plants in the clefts of the rocks, which are as steep as walls, and furnish some traces of stratification *. We found only an old trunk of aubletia †, with large pomiform fruit, and a new species of the family of the apocyneæ ‡. All the stones were covered with an innumerable quantity of iguanas and

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* In one single place we saw the granite of Baraguan stratified and divided into beds of three inches thick. The direction of these beds was N. 20° W.; and their dip 85° North-East. It was coarse-grained granite, stratified like that of Las Trincheras, and not gneiss. (See above, chap. xvi, p. 198.)

† Aubletia tiburba.

‡ Allamanda *salicifolia*.

geckoes with spreading and membranous fingers. These lizards, motionless, the head raised, and the mouth open, seemed to suck in the heated air. The thermometer placed against the rock rose to 50·2° *. The soil appeared undulating, from the effect of mirage, without a breath of wind being felt. The Sun was near the zenith, and it's dazzling light, reflected by the surface of the river, contrasted with the reddish vapours that enveloped all the surrounding objects. How vivid is the impression produced by the calm of nature, at noon, in these burning climates! The beasts of the forest retire to the thickets; the birds hide themselves beneath the foliage of the trees, or in the crevices of the rocks. Yet, amid this apparent silence, when we lend an attentive ear to the most feeble sounds transmitted by the air, we hear a dull vibration, a continual murmur, a hum of insects, that fill, if we may use the expression, all the lower strata of the air. Nothing is better fitted to make man feel the extent and power of organic life. Myriads of insects creep upon the soil, and flutter round the plants parched by the ardour of the Sun. A confused noise issues from every bush, from the decayed trunks of trees, from the clefts of the rock, and from the ground undermined by the lizards, millepedes, and *cecilias*. These are so many voices proclaiming to us, that all nature breathes; and that, under a thousand different forms, life is diffused throughout the cracked and dusty soil, as well as in the bosom of the waters, and in the air that circulates around us.

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* 40·1° R.

The sensations, which I here recalled to mind, are not unknown to those, who, without having advanced to the equator, have visited Italy, Spain, or Egypt. That contrast of motion and silence, that aspect of nature at once calm and animated, strikes the imagination of the traveller, when he enters the basin of the Mediterranean, within the zone of olives, dwarf palms, and date-trees.

We passed the night on the eastern bank of the Oroonoko, at the foot of a granitic hill. Near this desert spot was formerly seated the mission of San Regis. We could have wished to find a spring in the Baraguan. The water of the river had a smell of musk, and a sweetish taste extremely disagreeable. In the Oroonoko, as well as in the Apure, we are struck with the difference, that the various parts of the river exhibit near the most barren shore. The water is sometimes very potable, and sometimes seems to be loaded with gelatinous matter. "It is the *bark*" (the coriaceous covering) "of the putrified cayman, that is the cause," say the natives. "The more aged the cayman, the more *bitter his bark*." I have no doubt, that the carcasses of these large reptiles, those of the manatees, which weigh five hundred pounds, and the presence of the porpoises *(torinas)* with their mucilaginous skin, may contaminate the water, especially in the creeks, where the river has little velocity. Yet the spots, where we found the most fetid water, were not always those, where dead animals were accumulated on the beach. When, in such ardent climates, where we are constantly tormented by thirst, we are reduced to drink the water of a river at the temperature of 27° or 28°, it were to be wished at least, that water so hot, and so loaded with sand, should be free from smell.

April the 8th. We passed the mouths of the Suapure, or Sivapuri, and the Caripo, on the East; and that of the Sinaruco on the West. This last river is, next to the Rio Arauca, the most considerable between the Apure and the Meta. The Suapure, full of little cascades, is celebrated among the Indians for the quantity of wild honey, which the forests in it's neighbourhood afford. The meliponæ there suspend their enormous hives to the branches of trees. Father Gili navigated in 1766 on the Suapure, and on the Turiva, which falls into it. He there found tribes of the nation of Areverians. We passed the night a little below the island Macupina.

April the 9th. We arrived early in the morning at the *beach of Pararuma,* where we found an encampment of Indians, similar to that we had seen at the *Boca de la Tortuga.* They had assembled to search the sands, collect the turtles' eggs, and extract the oil; but they had unfortunately made a mistake of several days. The little turtles [*] had come out of their shells, before the Indians had formed their camp. Accordingly the crocodiles and the *garzes,* a species of large white herons, had availed themselves of the delay. These animals, alike fond of the flesh of the young turtles, devour an innumerable quantity. They fish during the night, for the *tortuguillos* do not come out of the earth, to gain the neighbouring river, till after the evening twilight. The *zamuro* vultures [†] are too indolent to hunt after sunset. They stalk around the shores in the day: alight in the midst of the Indian encampment, to steal provision; and often find no other means of satisfying their voracity, than by attacking young crocodiles of seven or eight inches long, either on the land, or in water of little depth. It is curious to see the address, with which these little animals defend themselves for some time against the vultures. As soon as they perceive them, they raise themselves on their fore paws, bend their back, and lift up the head, opening their wide jaws. They turn continually, though slowly, toward their enemy, to show him their teeth, which, even when the animal is recently come out of the egg, are already very long and sharp. Often while one of the zamuroes attracts the whole attention of a young crocodile, another seizes so favourable an opportunity for an unforeseen attack. He pounces on the crocodile, grasps it by the neck, and bears it off to the higher regions of the air. We had an opportunity of observing this manœuvre during several mornings, at the town of Mompex *, where we had collected more than forty crocodiles, that had been fifteen or twenty days hatched, in a spacious court surrounded by a wall.

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[*] *Los tortuguillos.*

[†] See above, chap. viii, vol. iii, p. 205.

We found among the Indians assembled at Pararuma some white men, who had come from Angostura to purchase the *manteca de tortuga*. After having wearied us for a long time with their complaints of the "bad harvest," and of the mischief done by the tigers among the turtles, at the moment of laying their eggs, they conducted us beneath an ajoupa, that rose in the centre of the Indian camp. We there found the missionary-monks of Carichana and the Cataracts seated on the ground, playing at cards, and smoking tobacco in long pipes. From their ample blue garments, their shorn heads, and their long beards, we might have taken them for natives of the East. These poor priests received us in the most affectionate manner, giving us every kind of information necessary for the continuation of our voyage. They had suffered from tertian fevers for some months; pale and emaciated, they easily convinced us, that the countries we were going to visit were not without danger to the health of travellers.

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* On the borders of the river Magdalena.

The Indian pilot, who had brought us from San Fernando de Apure as far as the shore of Pararuma, was unacquainted with the passage of the *rapids* * of the Oroonoko, and would not undertake to conduct our bark any farther. We were obliged to conform to his will. Happily for us, the missionary of Carichana consented to sell us a fine canoe at a very moderate price: and Father Bernardo Zea, missionary of the Atures and Maypures near the great cataracts, offered, though ill, to accompany us as far as the frontiers of Brazil. The number of natives, who assist in passing boats through the *Raudales* is so small, that, but for the presence of the monk, we should have risqued spending whole weeks in these humid and unhealthy regions. On the banks of the Oroonoko, the forests of the Rio Negro are considered as a delicious spot.

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* Little cascades, *chorros*, *raudalitos*.

The air is indeed cooler and more healthful. The river is free from crocodiles; you can bathe without apprehension, and by night as well as by day are less tormented by the stings of insects than on the Oroonoko. Father Zea hoped to reestablish his health by visiting the missions of Rio Negro. He talked of those places with that enthusiasm, which is felt in all the colonies of the continent for every thing far off.

The assemblage of Indians at Pararuma again excited in us that interest, which every where attaches man in a cultivated state to the study of men in a savage condition, and the successive developement of his intellectual faculties. How difficult to recognize in this infancy of society, in this assemblage of dull, silent, inanimate Indians, the primitive character of our species! Human nature is not here displayed with those features of artless simplicity, of which poets in every language have drawn such enchanting pictures. The savage of the Oroonoko appeared to us to be as hideous as the savage of the Missisippi, described by that philosophical traveller*, who best knew how to paint man under different climates. We are eager to persuade ourselves, that these natives, crouching before the fire, or seated on large shells of turtles, their bodies covered with earth and grease, their eyes stupidly fixed for whole hours on the beverage they are preparing, far from being the primitive type of our species, are a degenerate race, the feeble remains of nations, who, after having been long dispersed in the forests, are replunged into barbarism.

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* Mr. de Volney.

Red paint being in some sort the only clothing of the Indians, two kinds may be distinguished among them, according as they are more or less affluent. The common decoration of the Caribbees, the Otomacks, and the Jaruroes, is *onoto* *, called by the Spaniards *achote,* and by the planters of Cayenne *rocou.* It is the colouring matter extracted from the pulp of the bixa orellana †. The Indian women prepare the *onoto* by throwing the seeds of the plant into a tub filled with water. They beat this water for an hour, and then leave it to deposit tranquilly the colouring fecula, which is of an intense brick-red. After having separated the water, they take out the fecula, dry it between their hands, knead it with oil of turtles' eggs, and form it into round cakes of three or four ounces weight. When turtles' oil is wanting, some nations mix with the *onoto* the fat of the crocodile.

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* Properly *anoto.* This word belongs to the Tamanack Indians. The Maypures call it *majepa.* The Spanish missionaries say *onotarse,* to rub the skin with anotto, to *onoto* oneself.

† Even the word bixa, adopted by botanists, is derived from the ancient language of Haiti, or of the island of St. Domingo. *Rocou,* the term commonly used by the French, is derived from the Brazilian word, *urucu.*

Another pigment, much more valuable, is extracted from a plant of the family of the bignoniæ, which Mr. Bonpland has made known by the name of *bignonia chica*[*]. The Tamanacks call it *craviri*; the Maypures, *chirraviri*. It climbs up and clings to the tallest trees by the aid of tendrils. It's bilabiate flowers are an inch long, of a fine violet colour, and disposed by twoes or threes. The bipinnate leaves become reddish in drying. The fruit is a pod, filled with winged seeds; and is two feet long. This bignoniaceous plant grows spontaneously, and in great abundance, near Maypures; and in going up the Oroonoko, beyond the mouth of the Guaviara, from Santa Barbara to the lofty mountain of Duida, particularly near Esmeralda. We also found it on the banks of the Cassiquiare. The red pigment of *chica* is not obtained from the fruit, like the *onoto*, but from the leaves macerated in water. The colouring matter separates in the form of a light powder. It is collected, without being mixed with turtles' oil, into little loaves eight or nine inches long, and from two to three high, rounded at the edges.

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[*] *Plantes Equinoxiales*, vol. i, p. 108, pl. xxxi. *Gili, Saggio*, vol. i, p. 218.

These loaves, when heated, emit an agreeable smell of benzoin. When the *chica* is subjected to distillation, it yields no sensible traces of ammonia. It is not, like indigo, a substance combined with azot. It dissolves slightly in sulphuric and muriatic acids, and even in alkalis. Ground with oil, the *chica* furnishes a red colour, that has a tint of lake. Applied on wool, it might be confounded with madder red. There is no doubt, that the *chica*, unknown in Europe before our travels, may be employed usefully in the arts. The nations on the Oroonoko, by whom this pigment is best prepared, are the Salivas, the Guipunaves*, the Caveres, and the Piraoas. The processes of infusion and maceration are in general very common among all the nations on the Oroonoko. Thus the Maypures carry on a trade of barter with the little loaves of *puruma*, which is a vegetable fecula, dried in the manner of indigo, and yielding a very permanent yellow colour. The chemistry of the savage is reduced to the preparation of pigments, that of poisons, and the *dulcification* of the amylaceous roots, which the aroides and the euphorbiaceous plants afford.

The greater part of the missionaries of the Upper and Lower Oroonoko permit the Indians of their missions to paint their skins. It is painful to add, that some of them speculate on this state of nudity of the natives. In their huts, pompously called *conventos* *, I have often seen stores of *chica*, which they sold as high as four francs the cake *(turta)*. To form a just idea of the extravagance of the decoration of these naked Indians, I must observe, that a man of large stature gains with difficulty enough by the labour of a fortnight, to procure in exchange the *chica* necessary to paint himself red. Thus as we say in temperate climates of a poor man, " he has not enough to clothe himself," you hear the Indians of the Oroonoko say, " that man is so poor, that he has not enough to paint *(s'onoter, se majepayer)* half his body." The little trade in *chica* is carried on chiefly with the tribes of the Lower Oroonoko, whose country does not produce the plant that furnishes this much valued substance. The Caribbees and the Otomacks paint only the head and the hair with *chica*, but the Salivas possess this pigment in sufficient abundance, to cover their whole bodies. When the missionaries send on their own account small cargoes of cacao, tobacco, and *chiquichiqui* † from the Rio Negro to Angostura, they always add some cakes of *chica*, as being articles of merchandize in great request. Some persons of European race employ this red fecula, diluted in water, as an excellent diuretic.

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* Or Guaypunaves; they call themselves *Uipunavi*.

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* In the missions, the parsonage house bears the name of *convent*; it is *la casa del padre*.

† Ropes made with the petioles of a palm-tree with pinnate leaves, of which we shall speak in the sequel.

The custom of painting is not equally ancient among all the tribes of the Oroonoko. It has increased since the time when the powerful nation of the Caribbees made frequent incursions into those countries. The victors and the vanquished were alike naked; and to please the conqueror it was necessary to paint like him, and to assume his colour. The influence of the Caribbees has now ceased, and they remain circumscribed between the rivers Carony, Cuyuni, and Paraguamuzi; but the Caribbean fashion of painting the whole body is still preserved. The custom has survived the conquest.

Does the use of the onoto and chica derive it's origin from the desire of pleasing, and the taste for ornament, so common among the most savage nations? or must we suppose it to be founded on the observation, that these colouring and oily matters, with which the skin is plastered, preserve it from the sting of the moschettoes? I have often heard this question discussed in Europe; but in the missions of the Oroonoko, and wherever within the tropics the air is filled with venomous insects, the inquiry would appear at best idle. The Caribbee and the Saliva, who are painted red, are not less cruelly tormented by the *moschettoes* and the *zancudoes*, than the

Indians whose bodies are plastered with no colour. The sting of the insect causes no swelling in either; and scarcely ever produces those little pustules, which occasion such smarting and itching to Europeans recently disembarked. But the Native and the White suffer equally from the sting, till the insect has withdrawn it's sucker from the skin. After a thousand useless essays, Mr. Bonpland and myself tried the expedient of rubbing our hands and arms with the fat of the crocodile, and the oil of turtles' eggs; but we never felt the least relief, and were stung as before. I am not ignorant, that the Laplanders boast of oil and fat as the most useful preservatives; but the insects of Scandinavia are not of the same species as those of the Oroonoko. The smoke of tobacco drives away our gnats, while it is employed in vain against the *zancudoes*. If the application of fat and astringent* substances preserved the unhappy inhabitants of these countries from the torment of insects, as Father Gumilla pretends, why has not the custom of painting the skin become general on these very banks? Why do so many naked † natives paint only the face, though living in the neighbourhood of those* who paint the whole body?

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* The pulp of the anotta, and even the chica, are astringent and slightly purgative.

† The Guaypunaves, the Caveres, the Guahibes.

We are struck with the observation, that the Indians of the Oroonoko, like the natives of North America, prefer the substances that yield a red colour to every other. Is this predilection founded on the facility, with which the savage procures ochrey earths, or the colouring fecula of anotta, and of chica? I doubt this much. Indigo grows wild in a great part of Equinoctial America. This plant, like so many other leguminous plants, would have furnished the natives abundantly with pigments to colour themselves blue like the ancient Britons†. Yet we see no American tribe painted with indigo. It appears to me probable, as I have already hinted above, that the preference given by the Americans to the red colour is generally founded on the tendency, which nations feel to attribute the idea of beauty to whatever characterizes their national physiognomy. Men whose skin is naturally of a brownish red, love a red colour. If they be born with a forehead little raised, and the head flat, they endeavour to depress the forehead of their children. If they be distinguished from other nations by a thin beard, they try to eradicate the few hairs, that nature has given them. They think themselves embellished in proportion as they heighten the characteristic marks of their race, or of their national conformation.

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* The Caribbees, the Salives, the Tamanacks, and the Maypures.

† The half-clad nations of the temperate zone often paint their skin of the same colour, as that with which their clothes are dyed.

We were surprised to see, that, in the camp of Pararuma, the women far advanced in years were more occupied with their ornaments than the youngest women. We saw an Indian woman of the nation of the Otomacks employing two of her daughters in the operation of rubbing her hair with the oil of turtles' eggs, and painting her back with *onoto* and *caruto*. The ornament consisted of a sort of lattice work formed of black lines crossing each other on a red ground. Each little square had a black dot in the centre. It was a work of incredible patience. We returned from a very long herborization, and the painting was not half finished. This research of ornament seems the more singular, when we reflect, that the figures and marks are not produced by the process of *tatooing*, but that paintings executed with so much care * are effaced, if the Indian expose himself imprudently to a violent shower. There are some nations, that paint only to celebrate festivals; others are covered with colour during the whole year: and the latter consider the use of *onoto* as so indispensable, that both men and women would perhaps be less ashamed, to present themselves without a *guayuco** than destitute of paint. These *guayucoes* of the Oroonoko are partly bark of trees, and partly cotton cloth. Those of the men are broader than those worn by the women, who, the missionaries say, have in general a less lively feeling of modesty. A similar observation had been already made by Christopher Columbus. Must we not attribute this indifference, this want of delicacy in women belonging to nations of which the manners are not much depraved, to that rude state of slavery, to which the sex is reduced in South America by the men's injustice and the abuse of power?

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* The black and caustic pigment of the *caruto* (genipa Americana) however resists a long time the action of water, as we found with regret, having one day, in sport with the Indians, caused our faces to be marked with spots and strokes of Caruto. When we returned to Angostura, in the midst of Europeans, these marks were still visible.

When we speak in Europe of a native of Guyana, we figure to ourselves a man, whose head and waist are decorated with fine feathers of the macaw, the toucan, the tanager, and the humming bird. Our painters and sculptors have long since regarded these ornaments as the characteristic marks of an American. We were surprised at not finding in the Chayma missions, in the encampments of Uruana and of Pararuma, I might almost say on all the shores of the Oroonoko and the Cassiquiare, those fine plumes, those feathered aprons, which are so often brought by travellers from Cayenne and Demerary. These tribes for the most part, even those whose intellectual faculties are the most expanded, who cultivate alimentary plants, and know how to weave cotton, are altogether as naked*, as poor, and as destitute of ornaments, as the natives of New Holland. The excessive heat of the air, the profuse perspiration in which the body is bathed at every hour of the day and a great part of the night, render the use of clothes insupportable. Their objects of ornament, and particularly their plumes of feathers, are reserved for dances and solemn festivals. The plumes worn by the Guaypunaves † are the most celebrated for their choice of the fine feathers of manakins and parrots.

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* A word of the Caribbean language. The *perizoma* of the Indians of the Oroonoko is rather a band than an apron. See above, vol. iii, p. 231, 232.

The Indians are not always satisfied with one colour uniformly spread: they sometimes imitate in the most whimsical manner, in painting their skin, the form of European garments. We saw some at Pararuma, who were painted with a blue jacket and black buttons. The missionaries related to us, that the Guaynaves of the Rio Caura are accustomed to stain themselves red with anotta, and to make broad transverse stripes on the body, on which they stick spangles of silvery mica. Seen at a distance, these naked men appear to be dressed in laced clothes. If *painted nations* had been examined with the same attention as *clothed nations*, it would have been perceived, that the most fertile imagination, and the most mutable caprice, have created the fashions of painting, as well as those of garments.

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* For instance, the Macoes and the Piraoas. The Caribbees must be excepted, whose *perizoma* is a cotton cloth, so broad, that it might cover the shoulders.

† These came originally from the banks of the Inirida, one of the rivers that fall into the Guaviare.

Painting and tatooing are not restrained in either of the two worlds to one race, or one zone only. These kinds of ornaments are most common among the Malay and American races; but in the time of the Romans they existed also among the white race in the North of Europe. As the most picturesque garments and modes of dress are found in the Grecian Archipelago, and Western Asia, so, the type of beauty in painting and *tatooing* is diplayed by the islanders of the South Sea *. Some clothed nations still paint their hands, their nails, and their faces. It would seem, that painting is then confined to those parts of the body, that remain uncovered; and while *rouge,* which recalls to mind the savage state of man, disappears by degrees in Europe, (in some towns of the province of Peru) the ladies think they embellish their delicate and white skins, by covering them with colouring vegetable matter, starch, whites of eggs, and flour. After having lived a long time among men painted with anotta and *chica,* we are singularly struck with these remains of ancient barbarism, retained amid all the usages of civilization.

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* In the Archipelago of Mendoza's islands.

The encampment at Pararuma afforded us an opportunity of examining for the first time several animals alive, which till then we had seen only in the collections of Europe. These little animals form a branch of commerce for the missionaries. They exchange tobacco, the resin called *mani,* the pigment of chica, *gallitos* (rock manakins), orange monkeys, capuchin monkeys, and other species of monkeys in great request on the coast, for cloth, nails, hatchets, fish-hooks, and pins. The productions of the Oroonoko are bought at a low price of the Indians, who live in dependance on the monks; and these same Indians purchase of the monks at a very high price, and with the money they have gained at the *harvest of eggs,* fishing and gardening implements. We made the acquisition of several animals, which we kept with us throughout the rest of our voyage on the river, and studied their manners. I have published these observations in another work, and in order to avoid treating twice on the same subject, I shall here confine myself to the most succinct observations, adding the notes I have since found scattered among my journals.

The *gallitoes*, or rock manakins, that are sold at Pararuma, in pretty little cages made of the footstalks of palm-leaves, are infinitely more rare on the banks of the Oroonoko, and in the North and West of Equinoxial America, than in French Guyana. They have hitherto been found only near the mission of Encaramada, and in the *Raudales* or cataracts of Maypures. I say expressly *in* the cataracts, because these birds choose the hollows of the little granitic rocks, that cross the Oroonoko, and form such numerous cascades, for their habitual dwelling. We sometimes saw them appear in the morning in the midst of the foam of the river, calling their females, and fighting in the manner of our cocks, folding up the double moveable crest, that decorates the crown of their head. As the Indians very rarely take the full-grown *gallitoes*, and the males only are valued in Europe, which from the third year display a beautiful saffron colour, purchasers should be on their guard not to confound young females with young males. Both are of an olive-brown; but the *pollo*, or young male, is distinguishable at the earliest age, by it's size, and it's yellow feet. The female remains all her life of a dull dusky brown colour, with yellow only on the under wing-coverts and tips of the wings[*]. To preserve in our collections the fine tint of the plumage of a male and full-grown rock manakin, it must not be exposed to the light. This tint grows pale more easily than in the other genera of the passerine order. The young males, as in most other birds, have the plumage or livéry of their mother. I am surprised to see, that so excellent an observer as Mr. Le Vaillant[†] can doubt, whether the females in fact always remain of a dusky olive tint. The Indians of the *Raudales* all assured me, that they had never seen a saffron-coloured female.

Among the monkeys, that the Indians had brought to the fair of Pararuma, we distinguished several varieties of the *sai*[‡], belonging to the little groups of creeping monkeys called *matchi* in the Spanish colonies; marimondes[§], or *ateles* with a red belly; *titis*, and *viuditas*. The last two species particularly attracted our attention, and we purchased them to send to

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[*] Especially the part which ornithologists call the *carpus*.

[†] *Oiseaux de Paradis*, vol. ii, p. 61.

[‡] Simia capucina, capuchin monkey. See my Observ. de Zoologie, vol. i, p. 323—325, 336, and 355, on the confusion that prevails in the nomenclature of the sai and the neighbouring species.

[§] Simia belzebuth.

Europe[*]. We must not confound the *ouistiti*[†] of Buffon, which is the *titi* of Mr. d'Azara; the *titi*[‡] of Carthagena and the isthmus of Darien, which is the *pinche* of Buffon; and the *titi*[§] of the Oroonoko, which is the *saimiri* of French naturalists. In the different Spanish colonies the name of *titi* is given to monkeys, that belong to three different subgenera[||], and vary in the number of their grinders[¶]. This number excludes even the finest of the three *titis*, that of the Oroonoko, from the genus which Mr. Illiger has formed under the denomination of ouistiti, or *hapale*. It is almost needless to observe, after what I have said, how much it is to be wished, that we should abstain in works of science from those *vulgar names*, which, disfigured by our orthography, and varying in every province, augment the deplorable confusion of zoological nomenclature.

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[*] A fine saimiri, or titi of the Oroonoko, may be purchased at Pararuma for eight or nine piastres. The missionary pays one and a half to the Indian, who has caught and tamed the monkey.

[†] Simia jacchus, striate monkey.

[‡] Simia œdipus, red-tailed monkey.

[§] Simia sciurea, orange monkey.

[||] The genera callithrix, jacchus, and midas, of Mr. Geoffroy de St. Hilaire.

[¶] The titi of the Oroonoko (of the family of sagoins) has six grinders; the titis of Darien and Paraguay (of the family of hapales) have five grinders on each side.

The *titi* of the Oroonoko (simia sciurea), ill-drawn hitherto, though well known in our collections, is called *bititeni* by the Maypure Indians. It is very common to the South of the cataracts. It's face is white; and a little spot of bluish-black covers the mouth and the point of the nose. The *titis* of the most elegant form, and the most beautiful colour (with hair of a golden yellow), come from the banks of the Cassiquiare. Those that are taken on the shores of the Guaviare are large and difficult to tame. No other monkey has so much the physiognomy of a child as the *titi*; there are the same expression of innocence, the same playful smile, the same rapidity in the transition from joy to sorrow. It's large eyes are instantly filled with tears, when it is seized with fear. It is extremely fond of insects, particularly of spiders. The sagacity of this little animal is so great, that one of those we brought in our boat to Angostura distinguished perfectly the different plates annexed to the *Tableau élémentaire d'Histoire naturelle* of Mr. Cuvier. The engravings of this work are not coloured; yet the *titi* advanced rapidly it's little hand in the hope of catching a grasshopper or a wasp, every time that we showed it the eleventh plate, on which these insects are represented. It remained in the greatest indifference, when it was shown engravings of skeletons or heads of mammiferous animals *. When several of these little monkeys, shut up in the same cage, are exposed to the rain, and the habitual temperature of the air sinks suddenly two or three degrees, they twist their tail, which, however, is not prehensile, round their neck, and intertwine their arms and legs to warm one another. The Indian hunters told us, in the forests they often met groupes of ten or twelve of these animals, that sent forth lamentable cries, because those without endeavoured to enter amid the group to find warmth and shelter. By shooting arrows dipped in *weak poison* † at one of these groups, a great number of young monkeys are taken alive at once. The *titi* in falling remains clinging to it's mother. If it is not wounded by the fall, it does not quit the shoulder or the neck of the dead animal. Most of those that are found alive in the huts of the Indians have been thus taken from the dead bodies of their mothers. Those that are full grown, when cured of a slight wound, commonly die before they can accustom themselves to a domestic state. The *titis* are in general delicate and timid little animals. It is very difficult to convey them from the missions of the Oroonoko to the coast of Caraccas, or of Cumana. They become melancholy and dejected in proportion as they quit the region of the forests, and enter the Llanos. This change cannot be attributed to a slight increase of the temperature; it seems rather to depend on a greater intensity of light, a less degree of humidity, and some chemical property of the air of the coast.

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* I shall observe on this occasion, that I have never heard of a picture, on which hares or deer were represented of their natural size, and with the greatest perfection, having made the least impression even on hunting-dogs, the intelligence of which appeared the most improved. Is there an example well ascertained of a dog having recognized a full-length picture of it's master? In all these cases, the sight is not assisted by the smell.

† *Curare destemplado.*

The saimiris, or *titis* of the Oroonoko, the ateles, the sajous, and other quadrimanous animals long known in Europe, form a striking contrast both in their gait and habits with the *macavahu* *, called by the missionaries *viudita*, or *widow in mourning*. The hair of this little animal is soft, glossy, and of a fine black. It's face is covered with a mask of a square form, and a whitish colour tinged with blue. This mask contains the eyes, nose, and mouth. The ears have a rim: they are small, very pretty, and almost bare. The neck of the *widow* presents in front a white band, an inch broad, and forming a semicircle. The feet, or rather the hinder hands, are black like the rest of the body; but the fore hands are white without, and of a glossy black within. It is in these marks, or white spots, the missionaries think they recognize the veil, the neckerchief, and the gloves, of a *widow in mourning*. The character of this little monkey, which sits up on it's hinder extremities only when eating, is very little indicated in it's appearance. It has a wild and timid air; it often refuses the aliments that are offered to it, even when tormented by a ravenous appetite. It has little inclination for the society of other monkeys. The sight of the smallest saimiri puts it to flight. It's eye denotes great vivacity. We have seen it remain whole hours motionless without sleeping, and attentive to every thing that was passing around. But this wildness and timidity are merely apparent. The *viudita* alone, and left to itself, becomes furious at the aspect of a bird. It then climbs and runs with astonishing rapidity; darts upon it's prey like a cat; and kills whatever it can seize. This monkey, very rare, and very delicate, is found on the right bank of the Oroonoko, in the granitic mountains that rise behind the mission of Santa Barbara. It inhabits also the banks of the Guaviare, near San Fernando de Atabapo.

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* The Maravitan name of the simia lugens. See my *Observ. de Zoologie*, vol. i, p. 319.

The *viudita* accompanied us on our whole voyage on the Cassiquiare and the Rio Negro, passing the cataracts twice. In order to study the manners of animals, it is a great advantage to observe them during several months in the open air, and not in houses, where they lose all their natural vivacity.

The lading of the new canoe intended for us was begun this very evening. It was, like all Indian boats, a trunk of a tree hollowed out by the double means of the hatchet and of fire. It was forty feet long, and three broad. Three persons could not sit in it side by side. These canoes are so crank, they require, from their instability, a cargo so equally distributed, that, when you want to rise for an instant, you must warn the rowers *(bogas)* to lean to the opposite side. Without this precaution the water would necessarily enter the side pressed down. It is difficult to form a just idea of the inconveniences, that are suffered in such wretched vessels.

The missionary of the *Raudales* made the preparations for the voyage with greater activity than we wished. From fear of not having a sufficient number of Maco and Guahibe Indians, who are acquainted with the labyrinth of small channels and cascades, of which the *Raudales* or cataracts are composed, two Indians were put during the night in the *cepo;* that is to say, made to lie with their legs placed between two pieces of wood, notched and fastened together by a chain with a padlock. Early in the morning we were awakened by the cries of a young man, mercilessly beaten with a whip of manatee skin. His name was *Zerepe*, a very intelligent Indian, who was highly useful to us in the sequel, but who now refused to accompany us. Born in the mission of Atures, of a Maco father, and a mother of the nation of the Maypures, he had returned to the woods *(al monte)*, and had lived some years with the unsubdued Indians. He had thus acquired the knowledge of several languages, and the missionary employed him as an interpreter. We obtained with difficulty the pardon of this young man. "Without these acts of severity," we were told, "you would want for every thing. The Indians of the *Raudales* and the Upper Oroonoko are a stronger and more laborious race than the inhabitants of the Lower Oroonoko. They know, that they are much sought after at Angostura. If left to their own will, they would all go down the river to sell their productions, and live in full liberty among the Whites. The missions would be deserted."

These reasons are, I confess, more specious than true. Man, in order to enjoy the advantages of a social state, must no doubt sacrifice a part of his natural rights, and his ancient independence. But, if the sacrifice imposed on him be not compensated by the benefits of civilization, the savage, wise in his simplicity, retains the wish of returning to the forests that gave him birth. It is because the Indian of the woods is treated like a person in a state of villanage in the greater part of the missions, because he enjoys not the fruits of his labours, that the Christian establishments on the Oroonoko remain deserts. A government founded on the ruins of the liberty of the natives extinguishes the intellectual faculties, or stops their progress.

When it is said, that the savage, like the child, can be governed only by force, this is to establish false analogies. The Indians of the Oroonoko have something infantine in the expression of their joy, and the quick succession of their emotions; but they are not great children; they are as little so as the poor labourers in the East of Europe, whom the barbarism of our feudal institutions has held in the rudest state. To consider the employment of force as the first and sole means of the civilization of the savage, is a principle as far from being true in the education of nations, as in the education of youth. Whatever may be the state of weakness or degradation in our species, no faculty is entirely annihilated. The human understanding exhibits only different degrees of strength and development. The savage, like the child, compares the present with the past; he directs his actions, not according to blind instinct, but from motives of interest. Reason can every where enlighten reason; and it's progress will be retarded in proportion as the men, who think themselves called upon to bring up youth, or govern nations, proud of the feeling of their superiority, and despising those on whom they should act, think proper to substitute constraint and force for that moral influence, which can alone unfold the rising faculties, calm the irritated passions, and give stability to social order.

April the 10th. We could not set sail before ten in the morning. We could with difficulty reconcile ourselves to our new canoe, which we considered as a new prison. To gain something in breadth, a sort of lattice-work had been constructed on the after part of the boat with branches of trees, that on each side reached beyond the gunwale. Unfortunately, the roof of leaves *, that covered this lattice-work, was so low, that you were obliged to lie down, without seeing any thing, or, if seated, to sit nearly double. The necessity of carrying the canoe across the rapids, and even from one river to another; and the fear of giving too much hold to the wind, by making the *toldo* higher, render this construction necessary for vessels, that go up toward the Rio Negro. The shed was intended for four persons, lying on the deck or lattice-work of brushwood; but the legs reached far beyond it, and when it rained half the body was wetted. We are laid also upon ox-hides, or skins of tigers; and the branches of trees they are thrown over are painfully felt through so thin a covering. The fore part of the boat was filled with Indian rowers, furnished with paddles three feet long in the form of spoons. They are all naked, seated two by two, and row in cadence with a surprising uniformity. Their songs are sad, and monotonous. The small cages containing our birds and our monkeys, the number of which augmented as we advanced, were hung some to the *toldo*, and others to the bow of the boat. This was our *travelling menagery*. Notwithstanding the frequent losses occasioned by accidents, and above all by the fatal effects of exposure to the Sun, we had fourteen of these little animals alive at our return from the Cassiquiare. Naturalists, who wish to collect and bring living animals to Europe, might cause boats to be constructed expressly for this purpose at Angostura, or at Grand-Para, the two capitals situate on the banks of the Oroonoko and the Amazon, the first third of which boats might contain two rows of hutches sheltered from the ardour of the Sun. Every night, when we established our watch, the collection of animals and our instruments occupied the centre; around these were placed first our hammocks, then the hammocks of the Indians; and on the outside were the fires, that are thought indispensable against the attacks of the jaguar. About sunrise the monkeys in our cages answered the cries of the monkeys of the forest. These communications between animals of the same species sympathizing with one another, though unseen, one party enjoying that liberty, which the other regrets, have in them something melancholy and affecting.

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* *El toldo.*

In a canoe not three feet wide, and so incumbered, there remained no other place for the dried plants, trunks, a sextant, a dipping needle, and the meteorological instruments, than the space below the lattice-work of branches, on which we were compelled to remain stretched the greater part of the day. To take the least object out of a trunk, or to use an instrument, it was necessary to gain the shore and disembark. To these inconveniences were joined the torment of the moschettoes, that abounded under this low roof, and the heat that radiated from the leaves of the palm-trees, the upper surface of which was continually exposed to the solar rays. We attempted every instant, and always without success, to amend our situation. While one of us hid himself under a sheet, to ward off the insects, the other insisted on having green wood lighted beneath the *toldo*, in order to drive away the moschettoes by the smoke. The painful sensations of the eyes, and the increase of heat, already stifling, rendered both these means alike impracticable. With some gaiety of temper, with dispositions of mutual benevolence, and with a vivid taste for the majestic nature of these great valleys of rivers, travellers easily support evils that become habitual. I have entered into these minute details, only to paint the manner of navigating on the Oroonoko; and to prove, that, notwithstanding our earnest desire, Mr. Bonpland and I could not multiply our observations as much as the interesting nature of the surrounding objects demanded.

Our Indians showed us the place on the right bank of the river, where the mission of Pararuma, founded by the Jesuits about the year 1733, was formerly situated. The mortality occasioned by the smallpox among the Saliva Indians was the principal cause of the destruction of the mission. The few inhabitants, who survived this cruel epidemic, were joined to the village of Carichana, which we shall soon visit. It was at Pararuma, that, according to the testimony of Father Roman, hail was seen to fall during a great storm, about the middle of the last century. This is almost the only instance of it I know in a plain, that is nearly on a level with the sea; for hail falls generally between the tropics only at three hundred toises of elevation *.

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* See above, vol. iii, p. 463. In a very ingenious discussion on the meteorology of the tropics and of the temperate

If it form at an equal height over plains and table-lands, we must suppose, that it melts as it falls, in passing through the lowest strata of the atmosphere, the mean temperature of which (between 0ᵗ and 300ᵗ) is from 27·5° to 24° of the centigrade thermometer. I acknowledge it is very difficult to explain, in the present state of meteorology, why it hails at Philadelphia, at Rome, and at Montpellier, during the hottest months, the mean temperature of which attains 25° or 26°; while the same phenomenon is not observed at Cumana, at La Guayra, and, in general, in the equatorial plains. In the United States, and in the South of Europe, the heat of the plains (from 40° to 43° of latitude) is nearly the same as within the tropics; and according to my researches, the decrement of caloric equally varies but little. If then the absence of hail within the torrid zone, at the level of the sea, be produced by the melting of the hailstones in crossing the lower strata of the air, we

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zone, Thibault de Chanvalon puts the question, why, above the plains in the temperate zone only, storms are attended with hail. "The heat of the plains," he says, "can be no obstacle to the formation of hail; in Europe it is never more common than in the hot seasons." He asserts, that at Martinico hail has been seen to fall once in the plains, in 1721. (*Voyage à la Martinique*, p. 135, No. 40). This assertion appears questionable. (*Moreau de Jonnès sur le Climat des Antilles*, p. 49.)

must suppose, that these hailstones at the moment of their formation are larger in the temperate than in the torrid zone. We yet know so little of the conditions, under which water congeals in a stormy cloud in our climates, that we cannot judge whether the same conditions be fulfilled under the equator above the plains. I doubt hail's being always formed in a region of the air, of which the mean temperature is nought, and which with us is found in summer only at one thousand five hundred, or one thousand six hundred toises of height. The clouds, in which we hear the rattling of the hailstones against one another before they fall, and which move horizontally, have always appeared to me much less elevated: and at these smaller heights we may conceive, that extraordinary refrigerations are caused by the dilatation of the ascending air, of which the capacity for caloric augments; by currents of cold air coming from a higher latitude; and above all, according to Mr. Gay-Lussac, by the radiation from the upper surface of the clouds. I shall have occasion to return to this subject, when speaking of the different forms, under which hail and hoar-frost appear on the Andes, at two thousand and two thousand six hundred toises of height; and when examining the question, whether we may consider the stratum of clouds, that envelopes the mountains, as a horizontal continuation of the stratum, which we see immediately above us in the plains.

The Oroonoko, full of islands, begins to divide itself into several branches, of which the most western remained dry during the months of January and February. The total breadth of the river exceeds two thousand five hundred or three thousand toises. We perceived to the East, opposite the island of Javanavo, the mouth of the *Cano* Aujacoa. Between this *Cano* and the Rio Paruasi *, or Paruati, the country becomes more and more woody. A solitary rock, of an infinitely picturesque aspect, rises in the midst of a forest of palm-trees, not far from the Oroonoko †. It is a pillar of granite, a prismatic mass, the bare and steep sides of which attain nearly two hundred feet in height. It's top, which surpasses the highest trees of the forest, is terminated by a shelf of rocks, with a horizontal and smooth surface. Other trees crown this summit, which the missionaries call the peak, or *Mogote de Cocuyza*. This monument of nature, in it's simple grandeur, recalls to mind the Cyclopean monuments. It's outlines, strongly marked, and the group of trees and shrubs by which it is crowned, stand out from the azure of the sky. It seems a forest rising above a forest.

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* The Jesuit, Father Morillo, had formed on the banks of the Paruasi a mission of the same name, by assembling together some Maypoyes or Mapoi Indians; but it was soon abandoned. (*Gili*, vol. i, p. 37.)

† Opposite the *Hato de San Antonio*.

Farther on, near the mouth of the Paruasi, the Oroonoko narrows. On the East a mountain is perceived with a bare top, projecting in the form of a promontory. It is nearly three hundred feet high, and served as a fortress for the Jesuits. They had here constructed a small fort, which was furnished with three batteries of cannon, and constantly occupied by a military detachment. We saw these cannons dismounted, and half-buried in the sand, at Carichana and at Atures. The fort of the Jesuits (or *fortaleza de San Francisco Xavier)* has been destroyed since the dissolution of their society; but the place is still called *el Castillo.* I find it set down, in a manuscript map, lately constructed at Caraccas, by a member of the secular clergy, under the denomination of *Trinchera del despotismo monacal* *. In all revolutions the geographical nomenclature partakes of the spirit of innovation, that seizes on the multitude.

The garrison, which the Jesuits maintained on this rock, was not intended merely to protect the missions against the incursions of the Caribbees: it was employed also in an offensive war, or, as they say here, in the conquest of souls, *conquesta de almas.* The soldiers, excited by the allurement of gain, made military incursions *(entradas)* into the lands of the independant Indians. They killed all those who dared to make any resistance, burnt their huts, destroyed the plantations, and carried away the old men, women, and children, as prisoners. These prisoners were divided among the missions of the Meta, the Rio Negro, and the Upper Oroonoko. The most distant places were chosen, that they might not be tempted to return to their native country. This violent manner of *conquering souls*, though prohibited by the Spanish laws, was tolerated by the civil governors, and boasted of by the superiors of the society, as beneficial to religion, and the aggrandizement of the missions. "The voice of the Gospel is heard only," said a Jesuit of the Oroonoko * with simplicity, in the *Lettres Edifiantes*, "where the Indians have heard also the voice of arms; *el ecco de la polvera*. Mildness is a very slow measure. By chastising the natives, we facilitate their conversion." These principles, which degrade humanity, were certainly not common to all the members of a society, which in the New World, and wherever education has remained exclusively in the hands of monks, has rendered service to letters and civilization. But the *entradas*, the

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* *Intrenchment of monachal despotism.*

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* *Curtas edificantes de la Compania de Jesus*, 1757, vol. xvi, p. 92.

spiritual conquests with the assistance of bayonets, was an inherent vice in a system, that tended to the rapid aggrandizement of the missions. It is soothing to find, that the same system is not followed by the monks of St. Francisco, St. Dominic, and St. Augustin, who now govern a vast portion of South America; and who, by the mildness or harshness of their manners, exert a powerful influence over the fate of so many thousands of natives. Military incursions are almost entirely abolished; and when they do take place, they are disavowed by the superiors of the orders. We will not decide at present, whether this melioration of the monarchal system be owing to a want of activity, and a cold indolence; or must be attributed, as we would wish to believe, to the progress of knowledge, and to feelings more elevated, and more conformable to the true spirit of Christianity.

Beyond the mouth of the Rio Paruasi, the Oroonoko again narrows. Full of little islands and masses of granitic rocks, it presents *rapids*, or small cascades *, which at first sight may alarm the traveller, by the continual eddies of the water, but which at no season of the year are dangerous for boats. He must have navigated but little, who would say, with Father

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* *Los remolinos.*

Gili[*], in general so exact, and so judicious, "*e terribile pe' molti scogli il tratto del fiume tral Castello e Caricciana.*" A range of shoals, that crosses almost the whole river, bears the name of *Raudal de Marimara*[†]. We passed it without difficulty by a narrow channel, in which the water seems to boil up, as it issues out impetuously[‡] below the *Piedra de Marimara*, a compact mass of granite eighty feet high, and three hundred feet in circumference, without fissures, or any trace of stratification. The river penetrates far into the land, and forms spacious bays in the rocks. One of these bays, included between two promontories destitute of vegetation, is called the *Port of Carichana*[§]. The spot has a savage aspect. In the evening the rocky coasts project their vast shadows over the surface of the river. The waters appear black, from reflecting the image of these granitic masses, which, as we have already said, sometimes in the colour of their external surface resemble coal, and sometimes lead ore. We passed the night in the small village of Carichana, where we were received at the priest's house, or *convento*, from the recommendation of the worthy missionary, Fray Jose Antonio de Torre. It was nearly a fortnight since we had slept under a roof.

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[*] Vol. i, p. 11.

[†] We rocognize this name in that of the mountain of Castillo, which is *Marimaruta*, or *Marimarota*. (*Gumilla*, vol. i, p. 283.)

[‡] These places are called *chorreras* in the Spanish colonies.

[§] *Piedra y puerto de Carichana.*

April the 11th. To avoid the effects of the inundations, often so fatal to health, the mission of Carichana has been placed at three quarters of a league distance from the river. The Indians are of the nation of Salivas; they have a disagreeable and nasal pronunciation. Their language, of which the Jesuit Anisson has composed a grammar still in manuscript, is, with the Caribbean, the Tamanack, the Maypure, the Ottomack, the Guahive, and the Jaruro, one of the mother tongues most general on the Oroonoko. Father Gili [*] thinks, that the Ature, the Piraoa, and the Quaqua or Mapoje, are only dialects of the Saliva. My journey was much too rapid to enable me to judge of the accuracy of this assertion; but we shall soon see, that in the village of Atures, celebrated on account of it's situation near the great cataracts, neither the Saliva nor the Ature is now spoken, but the language of the Maypures. In the Saliva of Carichana, man is called *cocco*, woman *gnacu*, water *cagua*, fire *egussa*, the earth *seke*, the sky [†] *mumeseke*, (earth on high), the jaguar *impii*, the crocodile *cuipoo*, maize *giomu*, the plantain *paratunà*, cassava *peibe*. I shall mention one of those descriptive compounds, that seem to characterize the infancy of language, though they are retained in some very perfect idioms *. Thus, as in the Biscayan language, thunder is called "the noise of the cloud *(odotsa)*;" the Sun bears the name in the Saliva of *mume-seke-cocco*, the man *(cocco)* of the earth *(seke)* above *(mume)*.

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[*] Vol iii, p. 205.

[†] Ib. p. 21[illegible]

The most ancient abode of the Saliva nation appears to have been on the western banks of the Oroonoko, between the Rio Vichada † and the Guaviare, and also between the Meta and the Rio Paute. Salivas are now found not only at Carichina, but in the missions of the province of Casanre, at Cabapuna, Guanapalo, Cabiuna, and Macuco. The number of inhabitants in this last village, founded by the Jesuit Father Manuel Roman, in 1730, amounts to one thousand three hundred. The Salivas are a social, mild, almost timid people; and more easy, I will not say to civilize, but to subdue, than the other tribes on the Oroonoko. The Salivas, in order to escape from the dominion of the Caribbees, willingly joined the first missions of the Jesuits. Accordingly these Fathers every where in their writings praise the docility and intelligence of this people [*]. The Salivas have a great taste for music; in the most remote times they had trumpets of baked earth, four or five feet long, with several large globular cavities communicating with one another by narrow pipes. These trumpets send forth most dismal sounds. The Jesuits have cultivated with success the natural taste of the Salivas for instrumental music; and even since the destruction of the society, the missionaries of Rio Meta have continued at San Miguel de Macuco a fine church music, and musical instruction for the Indian youth. Very lately a traveller was surprised, to see the natives playing on the violin, the violoncello, the *triangle*, the guitar, and the flute [†].

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* See above, chap. ix, vol. iii, p. 269.

† The Saliva mission, on the rio Vichada, was destroyed by the Caribbees. (*Casani, Hist. gen., cap.* 26, p. 168.)

The system of the solitary missions of the Oroonoko is less favourable to the progress of civilization, and the increase of the population of the Salivas, than that which is adopted by the monks of Saint Augustin [‡] in the plains of Casanare, and of Meta. The natives of Macuco have improved from their intercourse with the

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[*] *Gumilla*, vol. i, chap. xiii, p. 209—224; *Gili*, vol. i, p. 67; vol. ii, p. 44.

[†] *Diario del Presbitero Josef Cortez Madariaga en su Viage de Santa Fe de Bogota por el Rio Meta a Caracas* (1811), fol. 15 (MS.).

[‡] *Recoletos*, depending on the great College de la Candelaria de Santa Fe de Bogota.

Whites, who inhabit the same village, and who are almost all refugees from Socorro[*]. At the Oroonoko, in the time of the Jesuits, the three villages of Pararuma, Castillo, or Marumarutu, and Carichana, were united into one, that of Carichana, which thence became a very considerable mission. In 1759, when the *Fortalza de San Francisco Xavier* and it's three batteries still existed, Father Caulin[†] reckoned four hundred Salivas in the mission of Carichana. In 1800 I found scarcely a hundred and fifty. There remains of this village only a few huts built with clay, and placed symmetrically around an immense cross.

We found among these Saliva Indians a white woman, the sister of a Jesuit of New Grenada. It is difficult to define the satisfaction that is felt, when, in the midst of nations of whose language you are ignorant, you meet with a being with whom you can converse without an interpreter.

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[*] The town of Socorro, South of the Rio Sogamozo, and North-North-East of Santa Fe de Bogota, was the centre of the insurrection, that broke out in the kingdom of New Grenada, in 1781, under the Archbishop-Viceroy Gongore, on account of the vexations which the people suffered from the introduction of the monopoly of tobacco. Many industrious inhabitants of Socorro emigrated at that time into the Llanos of Meta, to escape the persecutions, which followed the *general amnesty* granted by the court of Madrid. These emigrants are called in the missions, *Socorrenos refugiados*.

[†] *Hist. corografica*, p. 71.

Every mission has at least two interpreters (*lenguarazes*). They are Indians, a little less stupid than the rest, by whose means the missionaries of the Oroonoko, who now very rarely give themselves the trouble of studying the idioms of the country, communicate with the neophytes. These interpreters attended us in all our herborizations; but they rather understand than speak Castilian. With their indolent indifference, they answer us by chance, but always with an officious smile; "Yes, Father, no, Father," to every question addressed to them.

The vexation that arises from such conversation continued for months may easily be conceived, when you wish to be enlightened upon objects in which you take the most lively interest. We were often forced to employ several interpreters at a time, and several successive translators, in order to communicate with the natives *.

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* To form a just idea of the perplexity of these communications by interpreters, we may recollect, that, in the expedition of Lewis and Clarke to the river Columbia, in order to converse with the Chopunnish Indians, Captain Lewis addressed one of his men in *English*; that man translated the question into *French* to Chaboneau; Chaboneau translated it to his Indian wife in *Minnetaree;* the woman translated it into *Shoshonee* to a prisoner; and the prisoner translated it into Chopunnish. It may be feared, that the sense of the question was a little altered by five [four] successive translations.

"After leaving my mission," said the good monk of Uruana, "you will travel like mutes." This prediction was nearly accomplished; and, not to lose the advantage we might derive from intercourse even with the rudest Indians, we sometimes preferred the language of signs. When a native perceives that you will not employ an interpreter; when you interrogate him directly, showing him the objects; he rouzes himself from his habitual apathy, and displays an extraordinary capacity, to make himself comprehended. He varies the signs, pronounces the words slowly, and repeats them without being desired. The consequence conferred upon him, in suffering yourself to be instructed by him, flatters his self-love. This facility in making himself comprehended is particularly remarkable in the independant Indian: and in the Christian establishments I would advise travellers, to address themselves in preference to those of the natives, who have not been long *reduced*, or who from time to time return to the forest, to enjoy their former liberty*. It cannot be doubted that direct intercourse with the natives is more instructive and more certain, than the communication by interpreters †, provided the questions be simplified, and repeated to several individuals under different forms. The variety of idioms that are spoken on the banks of the Meta, the Oroonoko, the Cassiquiare, and the Rio Negro, is besides so prodigious, that a traveller, however great may be his talent for languages, can never flatter himself with learning enough to make himself understood along the navigable rivers, from Angostura to the small fort of San Carlos del Rio Negro. In Peru and Quito it is sufficient to know the Qquichua, or the Inca language; in Chili, the Araucan; and in Paraguay, the Guarany; in order to be understood by the greater part of the population. But it is not the same in the missions of Spanish Guyana, where nations of different races are mingled in the same village. It is not even sufficient, to have learned the Caribbee or Carina, the Guamo, the Guahive *, the Jaruro, the Ottomack, the Maypure, the Saliva, the Marivitan, the Maquiritare, and the Guaica, ten languages, of which there exist only imperfect grammars, and which have less affinity with each other than the Greek, the German, and the Persian.

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* *Indios neuvamente reducidos; Indios medio-reducidos, vagos, que vuelven almonte.*

† See above, chap. ix, vol. iii, p. 239—241.

The environs of the mission of Carichana appeared to us to be delightful. The little village is situate in one of those plains covered with

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* Pronounce *Gua-iva,* in Spanish *Guajiva.*

grasses, that separate all the links of the granitic mountains, from Encaramada as far as beyond the Cataracts of Maypures. The line of the forests is seen only in the distance. The horizon is every where bounded by mountains, partly woody, and of a dark tint; partly bare, with rocky summits, gilt by the beams of the setting Sun. What gives a peculiar character to the scenery of this country are banks of rock* nearly destitute of vegetation, that are often more than eight hundred feet in circumference, yet scarcely rise a few inches above the surrounding savannahs. They now make a part of the plain. We ask ourselves with surprise, whether some extraordinary revolutions have carried away the earth and plants; or the granite nucleus of our planet show itself bare, because the germes of life are not yet developed on all it's points. The same phenomenon seems to be found also in the *Shamo*, that separates Mungalia from China. Those banks of solitary rock in the desert are called *tsy*. I think they would be real table-lands, if the surrounding plains were stripped of the sand and mould that cover them, and which the waters have accumulated in the lowest places. On these stony flats of Cariohana we observed with eagerness the rising vegetation in the different degrees of it's development. We there found lichens cleaving the stone, and collected in crusts more or less thick; little portions of quartzose sand nourishing succulent plants; and lastly layers of black mould deposited in the hollows, formed from the decay of roots and leaves, and shaded by tufts of ever-green shrubs. I should not mention our gardens, and the timid works of art, if I had to speak of the great effects of nature; but this contrast of rocks and thickets loaded with flowers, these tufts of little trees scattered in the savannah, involuntarily recall to mind what our plantations display of most varied and most picturesque. It would seem as if man, guided by a deep feeling of the beauties of nature, had sought to soften the savage rudeness of these places.

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* *Laxas.*

At the distance of two or three leagues from the mission, we find, in these plains intersected by granitic hills, a vegetation no less rich than varied. On comparing the site of Carichana with that of all the villages above the Great Cataracts, we are surprised at the facility with which we traverse the country, without following the banks of the rivers, or being stopped by the thickness of the forests. Mr. Bonpland made several excursions on horseback, that furnished him with a rich harvest of plants[*]. I shall mention only the paraguatan, a magnificent species of the macrocnemum, the bark of which yields a red dye *; the guaricamo, with a poisonous root †; the jacaranda ‡ obtusifolia; and the *serrape*, or *jape* § of the Saliva Indians, which is the coumarouna of Aublet, so celebrated throughout Terra Firma for it's aromatic fruit. This fruit, which at Caraccas is placed among linen, as in Europe it is in snuff, under the name of the *tonca*, or *tongo* bean, is regarded as poisonous. It is a false notion, very general in the province of Cumana, that the excellent dram fabricated at Martinico owes it's peculiar flavour to the *jape*. In the missions it is called *simaruba*; a name that may occasion serious mistakes, the true *simaruba* being a febrifuge species of the quassia genus, found in Spanish Guyana only in the valley of Rio Caura, where the Paudacot Indians give it the name of *achecchari*.

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[*] Combretum *frangulæfolium*, bignonia *carichanensis*, b. *fluviatilis*, b. *salicifolia*, hypericum *eugeniæfolium*, convolvulus

I found the dip of the magnetic needle in the great square at Carichana 33·7° (new division). The intensity of the magnetic action was ex-

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discolor, casearia *capitata*, spathodia *orinocensis*, heliotropium *cinereum*, h. *filiforme*, &c.

* Macrocnemum *tinctorium*.

† Ityania coccinea.

‡ See our *Plantes Equinoxiales*, vol. i, p. 62, tab. 18.

§ Dipterix odorata, Willd., or baryosma tongo of Gaertner. The *jape* furnishes Carichana with an excellent timber.

pressed by two hundred and twenty-seven oscillations in ten minutes of time; an increase of force* that would seem to indicate some local attraction. Yet the blocks of the granite blackened by the waters of the Oroonoko have no perceptible action upon the needle. The barometric height at noon was 336·6 lines†; the centigrade thermometer being at 30·6° in the shade. The temperature of the air at night lowered to 26·2°; the hygrometer of Deluc keeping at 46°.

The river had risen several inches in the day, on the 10th of April; this phenomenon surprised the natives so much the more, as the first swellings are almost imperceptible, and are usually followed in the month of April by a fall for some days. The Oroonoko was already three feet higher than the level of the lowest waters. The natives showed us on a granitic wall the traces of the great rise of the waters of late years. We found them to be forty-two feet‡ high, which is double the mean rise of the Nile. But this measure was taken in a place, where the bed of the Oroonoko is singularly hemmed in by rocks, and I could only notice the marks shown me by the natives. It may easily be conceived, that the effect and the height of the increase differs according to the profile of the river, the nature of the banks more or less elevated, the number of rivers flowing in, that collect the pluvial waters, and the length of ground passed over. What is indubitable, and has struck the imagination of all who inhabit these countries, is, that at Carichana, at San Borja, at Atures, and at Maypures, wherever the river has forced it's way through the mountains, you see at a hundred, sometimes at a hundred and thirty feet, above the highest present increase of the river, black bands and erosions, that indicate the ancient abode of the waters. Is this river then, the Oroonoko, which appears to us so grand and so majestic, only the feeble remains of those immense currents of fresh water, which, swelled by Alpine snows, or by more abundant rains, every where shaded by thick forests, and destitute of those shores that favour evaporation, heretofore traversed the country at the East of the Andes, like arms of inland seas? What must have been the state of those low countries of Guyana, that now undergo the effects of annual inundations? What immense numbers of crocodiles, manatees, and boas must have inhabited these vast spaces of land, converted alternately into marshes of stagnant water, and into barren and fissured plains! The more peaceful world which we inhabit has then succeeded to a world of tumult. The bones of mastodontes and real American elephants are found dispersed on the table-lands of the Andes. The megatherium inhabited the plains of Uruguay. On digging deep into the ground in high vallies, where neither palm-trees nor arborescent ferns can grow, strata of coal are discovered, that imbed gigantic vestiges of monocotyledonous plants.

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* See above, chap. xviii. p. 416. The latitude of Carichana, deduced from that of Uruana and of the mouth of the Meta, is 6° 29′.

† The barometer, in the port of Carichana, kept at six in the evening, at 335·7 lines; the thermometer in the open air, at 26·8°. See above, p. 455.

‡ Or thirteen metres and half. The height of the mean rise of the Nile is fourteen cubits of the Nilometer of Elephantino, or 7·41 metres.

There was a remote period then, in which the classes of plants were otherwise distributed, when the animals were larger and the rivers broader and of greater depth. There end those records of Nature, that it is in our power to consult. We are ignorant whether the human race, which at the time of the discovery of America scarcely formed a few feeble tribes on the East of the Cordilleras, had already descended into the plains; or whether the ancient tradition of the *great waters*, which is found among the nations of the Oroonoko, the Erevato, and the Caura, belong to other climates, whence it has been propagated to this part of the New Continent.

April the 11th. We left Carichana at two in the afternoon, and found the course of the river more and more encumbered by blocks of granite rocks. We passed on the West the Cano Orupe *, and then the great rock known by the name of *Piedra del Tigre.* The river is there so deep, that no bottom can be found with a line of twenty-two fathoms. Toward evening the weather became cloudy and gloomy. The proximity of the storm was marked by squalls alternating with dead calms. The rain was violent, and the roof of foliage, under which we lay, afforded but little shelter. Happily these showers drove away, at least for some time, the moschettoes, with which we had been severely tormented during the day. We found ourselves before the cataract of Cariven, and the impulse of the waters was so strong, that we had great difficulty in gaining the land. We were continually driven back to the middle of the current. At length two Saliva Indians, excellent swimmers, leaped into the water, and drew the boat to shore by means of a rope; and made it fast to the *Piedra de Carichana vieja,* a shelf of bare rock, on which we passed the night. The thunder continued to roll during a part of the night; the increase of the river became considerable; and we were several times afraid, that our frail bark would be forced from the shore by the impetuosity of the waves.

The granitic rock on which we lay is one of

* *Urupi.*

those, where travellers on the Oroonoko have heard from time to time, toward sunrise, subterraneous sounds, resembling those of the organ. The missionaries call these stones *laxas de musica.* "It is witchcraft *(cosa de bruxas),*" said our young Indian pilot, who could speak Spanish. We never ourselves heard these mysterious sounds, either at *Carichana vieja,* or in the Upper Oroonoko; but from information given us by witnesses worthy of belief, the existence of a phenomenon, that seems to depend on a certain state of the atmosphere, cannot be denied. The shelves of rock are full of very narrow and deep crevices. They are heated during the day to 48° or 50°. I often found their temperature at the surface, during the night, at 39°, the circumambient atmosphere being at 28°. It may easily be conceived, that the difference of temperature between the subterraneous and the external air attains it's maximum about sunrise, or at that moment which is at the same time farthest from the period of the maximum of the heat of the preceding day. May not these sounds of an organ then, which are heard when a person sleeps upon the rock, his ear in contact with the stone, be the effect of a current of air, that issues out through the crevices? Does not the impulse of the air against the elastic spangles of mica, that intercept the crevices, contribute to modify the sounds? May we not admit, that the ancient inhabitants of Egypt, in passing incessantly up and down the Nile, had made the same observation on some rock of the Thebaid; and that the *music of the rocks* there led to the jugglery of the priests in the statue of Memnon? Perhaps, when "the rosy-fingered Aurora rendered her son, the glorious Memnon, vocal *," the voice was that of a man hidden beneath the pedestal of the statue; but the observation of the natives of the Oroonoko, which we relate, seems to explain in a natural manner what gave rise to the Egyptian belief of a stone, that poured forth sounds at sunrise.

Almost at the same period, at which I communicated these conjectures to some of the learned of Europe, three French travellers, Messrs. Jomard, Jollois, and Devilliers, were led to analogous ideas. They heard at sunrise, in a monument of granite placed at the centre of the spot on which the palace of Karnak stands, a noise resembling that of a string breaking. Now this comparison is precisely that, which the ancients employed in speaking of the voice of Memnon. The French travellers thought like me, that the passage of rarified air through the fissures of a sonorous stone might have suggested to the Egyptian priests, to invent the juggleries of the Memnonium *.

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* These are the words of an inscription, which attests, that sounds were heard on the 13th of the month Pachos, in the tenth year of the reign of Antoninus. See *Mon. de l'Egypte ancienne*, vol. ii, pl. xxii, fig. 6.

April the 12th. We set off at four in the morning. The missionary foresaw, that we should have great difficulty in passing the *rapids* and the mouth of the Meta. The Indians rowed twelve hours and a half without intermission. During this time, they took no other nourishment than cassava and plantains. When we consider the difficulty of overcoming the impetuosity of the current, and of passing the cataracts; when we reflect on the constant employment of the muscular powers, during a navigation of two months; we are equally surprised at the constitutional vigour and the abstinence of the Indians of the Oroonoko and the Amazon. Amylaceous and saccharine substances, sometimes fish and the fat of turtles' eggs, supply the place of food drawn from the first two classes † of the animal kingdom, those of quadrupeds and birds.

We found the bed of the river, to the length of six hundred toises, full of granitic rocks. Here is what is called the *Raudal de Cariven* ‡. We passed through channels that were not five feet broad. Our canoe was sometimes jammed between two blocks of granite. We sought to avoid those passages, into which the waters rushed with a horrible noise. There is no real danger, when you are steered by a good Indian pilot. When the current is too difficult to resist, the rowers leap into the water, and fasten a rope to the point of a rock, to warp the boat along. This manœuvre is very slow; and we sometimes availed ourselves of it, to climb the rocks among which we were entangled. They are of all dimensions, rounded, very black, glossy like lead, and destitute of vegetation. It is an extraordinary sight, to see the waters of one of the largest rivers on the Globe in some sort disappear. We perceived even far from the shore those immense blocks of granite, rising from the ground, and leaning one against another. The intervening channels in the Rapids are more than twenty-five fathoms deep; and are the more difficult to be observed, as the rocks are often narrow toward their bases, and form vaults suspended over the surface of the river. We perceived no crocodiles in the *Raudal de Cariven*; these animals seem to shun the noise of cataracts.

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* Ib. vol. i, p. 108 and 234.

† Animals with red and warm blood.

‡ Or *Cariceni.*

From Cabruta to the mouth of the Rio Sinaruco, a distance of nearly two degrees of latitude, the left bank of the Oroonoko is entirely uninhabited; but to the West of the *Raudal de*

Cariven an enterprising man, Don Felix Relinchon, has assembled some Jaruro and Otomack Indians in a small village. It is an attempt at civilization, on which the monks have had no direct influence. It is superfluous to add, that Don Felix lives at open war with the missionaries on the right bank of the Oroonoko. We shall discuss in another place the important question, whether in the present state of Spanish America these *Capitanes pobladores* and *fundadores* can be substituted for the monastic system, and which of these two governments, alike capricious and arbitrary, is most to be dreaded by the poor Indians.

Going up the river we arrived at nine in the morning before the mouth of the Meta, opposite the spot where the mission of Santa Teresa, founded by the Jesuits, was heretofore situate.

Next to the Guaviare the Meta is the most considerable river that flows into the Oroonoko. It may be compared to the Danube, not for the length of it's course, but for the volume of it's waters. It's mean depth is thirty-six feet, and it reaches as far as eighty-four. The union of these two rivers presents a very impressive aspect. Lonely rocks rise on the eastern bank. Blocks of granite, piled upon one another, appear from afar like castles in ruins. Vast sandy shores keep the skirting of forest at a distance from the river; but we discover amid them in the horizon solitary palm-trees, backed by the sky, and crowning the tops of the mountains.

We passed two hours on a large rock, standing in the middle of the Oroonoko, and called the *Stone of Patience* *, because the canoes, in going up, are sometimes detained there two days, to extricate themselves from the whirlpool caused by this rock. I succeeded in fixing my instruments on it. Altitudes of the Sun gave me 70° 4′ 29″ † for the longitude of the mouth of the Meta. This chronometric observation proves, that in this point the map of South America by d'Anville is almost exempt from error in longitude, while the error in latitude is a whole degree.

The Rio Meta, which traverses the vast plains of Casanare, and which is navigable as far as the foot of the Andes of New Grenada, will one day be of great political importance to the inhabitants of Guyana and Venezuela. From the Golfo Tristo and the Mouth of the Dragon a small fleet may go up the Oroonoko and the

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* *Piedra de la Paciencia.*

† See my *Obs. Astr.*, vol. i, p. 222. Father Caulin, speaking of the observations made on the expedition of Iturriaga and Solano, in 1756, says expressly, that the latitude of the mouth of the Meta is 6° 20′ (*Hist. Corografica*, p. 70); yet in the maps constructed according to these same observations, those of Surville and La Cruz, we find the mouth of the Meta in 6° 7′ and 6° 10′. Gumilla thought it in 1° 58′; Gili, in 4° 20′.

Meta to within fifteen or twenty leagues of Santa Fe de Bogota. The flour of New Grenada may be conveyed down the same way. The Meta is like a canal of communication between countries placed in the same latitude, but differing in their productions as much as France and Senegal. This circumstance gives importance to the exact knowledge of the sources of a river so badly laid down in our maps. The Meta takes it's origin from the union of two rivers, that descend from the Paramoes of Chingasa and Suma Paz. The first is the Rio Negro, which lower down receives the Pachaquiaro; the second is the Rio de Aguas Blancas, or Umadea. The junction takes place near the port of Marayal. There are only eight or ten leagues distance from the Passo de la Cabulla, where you quit the Rio Negro, to the capital of Santa Fe. I noted these curious facts, such as I had collected them from ocular witnesses, in the first edition of my map of the Rio Meta. The narrative of the voyage of the canon Don Josef Cortes Madariaga has not only confirmed all I had marked in my first sketches of the sources of the Meta, but has furnished me with some valuable materials for completing my labours. From the villages of Xiramena and Cabullaro to those of Guanapalo and Santa Rosalia de Cabapuna, a distance of sixty leagues, the banks of the Meta are more inhabited than those of the Oroonoko. We find in this space fourteen Christian settlements, in part very populous; but from the mouths of the rivers Pauto and Casanare, for a space of more than fifty leagues, the Meta is infested by the Guahiboes *, who are savages.

The navigation of this river was much more active in the time of the Jesuits, and particularly during the expedition of Iturriaga, in 1756, than it is at present. Missionaries of the same order then governed the banks of the Meta and of the Oroonoko. The villages of Macuco, Zurimena, and Casimena, were founded by the Jesuits, as well as those of Uruana, Encaramada, and Carichana.

These fathers had conceived the project of forming a series of missions from the junction of the Casanare with the Meta to that of the Meta with the Oroonoko. A narrow zone of cultivated land would have crossed the vast steppes, that separate the forests of Guyana from the Andes of New Grenada.

At the period of the *harvest of turtles' eggs*, not only the flour of Santa Fe descended the river, but the salt of Chita †, the cotton cloth of San Gil, and the printed counterpanes of Socorro. To give some security to the little traders, who devoted themselves to this inland commerce, attacks were made from time to time, from the *Castillo* or fort of Carichana, on the Guahiboes.

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* I find the word written *Guajibos*, *Guahivos*, and *Guagivos*. They call themselves *Gua-ivos*.

† To the East of Labranza Grande, and the North-West of Pore, now the capital of the province of Casanare.

The same means, that favoured the sale of the productions of New Grenada, having served to introduce a contraband trade on the coasts of Guyana, the merchants of Carthagena have induced the government to put heavy shackles on the freedom of commerce on the Meta. The same spirit of monopoly has shut up the Meta, the Rio Atracto, and the river of Amazons. Strange policy that, which teaches mother-countries to leave those regions uncultivated, where nature has deposited all the germes of fertility! The wild Indians have every where availed themselves of this want of population. They have drawn near the rivers, they molest the passengers, and attempt to reconquer what they have lost for so many ages. In order to hold the Guahiboes in awe, the Capuchin missionaries, who succeeded the Jesuits in the government of the missions of the Oroonoko, formed the project of founding a city at the mouth of the Meta, under the name of the *Villa de San Carlos*. Indolence, and the dread of tertian fevers, have prevented the execution of this project; and all that has ever existed of the city of San Carlos, is a coat of arms painted on fine parchment, with an enormous cross erected on the bank of the Meta. The Guahiboes, who it is said are some thousands in number, are become so insolent, that, at the time of our passage by Carichana, they sent word to the missionary, that they would come on rafts, and burn his village. These rafts *(valzas)*, which we had an opportunity of seeing, are scarcely three feet broad, and twelve feet long. They carry only two or three Indians; but fifteen or sixteen of these rafts are fastened to each other with the stems of the paullinia, the dolichos, and other creeping plants. It is difficult to conceive how these small craft remain tied together in passing the *rapids*. Many fugitives from the villages of the Casanare and the Apure have joined the Guahiboes, and taught them the practice of eating beef, and procuring hides. The farms of San Vicente, Rubio, and San Antonio, have lost great numbers of their horned cattle by the incursions of the Indians. They also prevent travellers, as far as the junction of the Casanare, from sleeping on the shore in going up the Meta. It often happens while the waters are low, that the little traders of New Grenada, some of whom still visit the encampment of Pararuma, are killed by the poisoned arrows of the Guahiboes.

From the mouth of the Meta the Oroonoko appeared to us to be freer from shoals and rocks. We navigated in a channel five hundred toises broad. The Indians remained rowing in the boat, without towing or pushing it forward with their arms, and wearying us with their savage cries. We passed the *Canos* of Uita and Endava on the West. It was night when we reached the *Raudal de Tabaje* *. The Indians would not hazard passing the cataract; and we slept on a very incommodious spot, on the shelf of a rock, with a slope of more than eighteen degrees, and of which the crevices sheltered a swarm of bats. We heard the cries of the jaguar very near us during the whole night. They were answered by our great dog in lengthened howlings. I waited the appearance of the stars in vain; the sky was of a tremendous blackness; and the hoarse sounds of the cascades of the Oroonoko contrasted with the noise of the thunder, that was rolling at a distance toward the forest.

April the 13th. Early in the morning we passed the *Rapids* of *Tabaje*, the limit of Father Gumilla's voyage †, and again disembarked. Father Zea, who accompanied us, desired to perform mass in the new mission of San Borja, established two years before. We there found six houses inhabited by uncatechised Guahiboes.

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* *Tavaje*, no doubt *Atavaje*.

† *Orenoque illustré* (French translation), vol. i, p. 49 and 77. Yet Gumilla affirms, p. 66, that he navigated the Guaviare. He places the *Raudal de Tabaje* in lat. 1° 4′, an error of 5° 10′.

They differ in nothing from the wild Indians. Their eyes, pretty large and black, expressed more vivacity than those of the Indians who inhabit the ancient missions. We in vain offered them brandy: they would not even taste it. The faces of all the young girls were marked with round black spots; like the *patches*, by which the women of Europe formerly imagined they set off the whiteness of their skins. The bodies of the Guahiboes were not painted. Several of them had beards, of which they seemed proud; and, taking us by the chin, showed us by signs, that they were made like us. Their shape was in general slender. I was again struck, as I had been among the Salivas and the Macoes, with the little uniformity of features to be found in the Indians of the Oroonoko. Their look is sad and gloomy; but neither stern nor ferocious. Without having any notion of the practices of the Christian religion (the missionary of Carichana celebrates mass at San Borja only three or four times a year), they behaved with the utmost decency at church. The Indians love to exhibit themselves; and will submit temporarily to any restraint or subjection, provided they are sure of drawing attention. At the moment of the consecration, they made signs to one another, to indicate beforehand, that the priest was going to carry the chalice to his lips. With the exception of this gesture, they remained motionless and in imperturbable apathy.

The interest with which we examined these poor savages became perhaps the cause of the destruction of the mission. Some among them, who preferred a wandering life to the labours of agriculture, persuaded the rest to return to the plains of the Meta. They told them, "that the white men would come back to San Borja, to take them away in the boats, and sell them as *poitos*, or slaves, at Angostura." The Guahiboes awaited the news of our return from the Rio Negro by the Cassiquiare; and when they heard that we were arrived at the first great cataract, that of Atures, they all deserted, and fled to the savannahs that border the Oroonoko on the West. The Jesuit Fathers had already formed a mission on this spot, and bearing the same name. No tribe is more difficult to fix to the soil than the Guahiboes. They like better to feed on stinking fish, scolopendras, and worms, than to cultivate a little spot of ground. The other Indians say, that "a Guahibo eats every thing that exists above, and every thing under ground."

In ascending the Oroonoko more to the South, the heat, far from increasing, became easier to bear. The air in the day was at 26° or 27·5° *; and at night, at 23·7° †. The water of the

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* 20·8° or 22° R.

† 19° R.

Oroonoko retained it's habitual temperature of 27·7°[*]. The torment of the moschettoes augmented severely, notwithstanding the decrease of the heat. We had never suffered so much from them as at San Borja. We could neither speak nor uncover the face, without the mouth and nose being filled with insects. We were surprised not to find the thermometer at 35° or 36°; the extreme irritation of the skin made us believe, that the air was scorching. We passed the night on the beach of Guaripo[†]. The fear of the little caribe fish prevented us from bathing. The crocodiles we had met with this day were all of an extraordinary size, from twenty-two to twenty-four feet.

April the 14th. Our sufferings from the *zancudoes* made us depart at five o'clock in the morning. There are fewer insects in the strata of air that repose immediately on the river, than near the edge of the forests. We stopped to breakfast at the island of Guachaco[‡], where the granite is immediately covered by a formation of sandstone, or agglomerate. This sandstone contains fragments of quartz, and even of feldspar, cemented by indurated clay. It exhibits little veins of brown iron ore, which separate in laminæ, or plates, of one line in thickness. We had already found these plates on the shores between Encaramada and Baraguan, where the missionaries had sometimes taken them for an ore of gold, and sometimes for tin. It is probable, that this secondary formation occupied formerly a larger space. Having passed the mouth of the Rio Parueni, beyond which the Maco Indians dwell, we spent the night on the island of Panumana. I could with difficulty take the altitudes of Canopus, in order to fix the longitude* of the point, near which the river suddenly turns toward the West. The island of Panumana is rich in plants. We there again found those shelves of bare rock, those tufts of melastomas, those thickets of small shrubs, the blended scenery of which had charmed us in the plains of Carichana. The mountains of the Great Cataracts bounded the horizon toward the South-East. In proportion as we advanced, we perceived that the shores of the Oroonoko exhibited a more imposing and picturesque aspect.

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[*] 22·2° R.

[†] Height of the barometer, at 6h in the evening, 335·6 lines; cent. therm., 25·3°. The little irregularities of the horary variations render the influence of the slope of the river on the height of the barometer scarcely perceptible.

[‡] Or *Vachaco*.

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* Long. 70° 8′ 39″; admitting, according to the itinerary distances, the latitude of the island to be 5° 41′.

END OF VOL. IV.

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